NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

No. 34. Vol. V. DECEMBER, 1894.

NOTES AND COMMENTS.

The Scots Fishery Board.

IN our September number we were able to announce that Mr. John Murray, of the "Challenger," was very strongly supported by leading scientific men for the post of Chairman of the Scots Fishery Board, in succession to the late Mr. Peter Esslemont. The appointment is made by the Crown, and no doubt the recommendation of the Scots Secretary is the important factor in determining the decision. Mr. Murray seemed peculiarly marked out for the post, from his special attainments in connection with marine biology, and from his long and capable service under Government in connection with the "Challenger" expedition and the "Challenger" reports. Most of our readers are now aware that Mr. Angus Sutherland, the Liberal Member of Parliament for Sutherlandshire, has been appointed chairman, and has in consequence vacated what may be regarded as a safe Government seat.

As this seems a post which, to the great advantage of the State, might be filled by a man of special distinction in science, it is worth while going into the history and nature of the Board. Like so many excellent Scots institutions, it dates back in origin to a time long preceding the date at which Scotland began to enjoy the advantage of union with England. The first White Herring Fishery Board was founded in the 14th century, no doubt with a view to secure some benefit to the Crown from sea-fishery. The Board of British White Herring Fishery, the parent of the present Board, was established by 48 Geo. III., c. 110, and was dissolved in 1882 by the 45 and 46 Vict., c. 78, which established the present Fishery Board and is the basis of its action. The Act provided that the Board should consist of the sheriffs of three sheriffdoms, to be selected by the Crown, and six other members to be appointed by the Crown. The Crown nominates one member to be chairman, who has a salary of £800 per annum, and appoints the secretary,

who has a salary of £300–£400. The Secretary of State of the Home Department appoints the inspector of salmon fisheries, who has a salary of £600.

The Board have the appointment of all the other offices, such as the general inspector of sea fisheries, with salary of £300–£350, an assistant, with salary of £250–£280, and a number of minor appointments. £1,800 is given to the Board to spend in scientific investigation: they opened at Dunbar about twelve months ago their first fish-hatching establishment.

The Board have the general superintendence of the salmon fisheries of Scotland, and take such measures for their improvement as the funds under their administration allow. They are the only authorised authority for branding herrings, and from this source they derive an annual income of about £8,000. They look after the piers and quays under the authority of 5 Geo. IV., c. 64. Their expenditure under all heads amounts to about £28,000 a year. At the beginning of this year the only scientific member of the Board was Professor McIntosh, of St. Andrew's.

Here, then, is a great permanent department with most important duties and with a jurisdiction extending over all Scotland and the Northumberland coast. For the administrative and executive duties, the permanent staff and a board of intelligent persons selected for any reason whatever should suffice. But nothing is clearer than that the main object of expenditure should be the maintenance and improvement of Fisheries, now that the income is no mere wresting of taxes for the Crown. The regulation and repair of piers and quays, and commercial necessities like the branding of standard qualities, are matters within the intelligence of most. The times and seasons for protection, the regulation of trawling, the provision of bait, and above all the extension of fish-hatching stations are matters that can be solved only by trained scientific experts. Sheriffs, in Scotland, are necessarily learned men; Members of Parliament, no doubt, have special abilities and have the opportunity of being in touch with the practical needs of their fisher-constituents. But it is urgent and imperative that in this country, as in France and America and Russia, departments dealing with problems soluble only by science should be under the responsible control of scientific men.

This is no question of Mr. Angus Sutherland and Mr. John Murray: it depends upon no weighing of their personal capacities. The choice of individuals is best left in the hands of a responsible department, and many considerations unknown even to omniscient editors may select or reject an individual. The choice of the kind of individual should not be left to Government.

SCIENCE AND THE STATE.

FOR the selection, by Government, of the wrong kind of individuals for posts that should imply scientific knowledge in the holders,

we blame not Government, but men of science. In all matters touching State-craft the habit of these is to hold aloof superiorly, leaving mere politics to the common man, or to rush belated into a controversy, delaying compromise by new discharge of venom. The savant in his laboratory, ignorant of the bombardment of his city, is a figure that tickles the fancy, but should offend the judgment. The irruption into the Irish controversy of a great scientific man, since unhappily dead, and his easy pre-eminence among irreconcilable and turbulent partisans, was food for laughter and tears. Scientific men have no right to wait till controversies strike down to their elemental passions. They must take their part as citizens in daily conduct of the State. Otherwise, when the pinch comes, they will be unschooled in the diametrical opposition between political and scientific knowledge as bases of action. In scientific action the expedient depends upon the recognition of what may be certain among facts; in political action the expedient depends upon the recognition that no facts are certain.

Thus scientific men have succeeded in gaining a reputation, especially among politicians, for acting in the conduct of affairs either negligently or with virulent self-confidence; whereas the fact is that what error of this kind lies in them is no more frequent than the corresponding error of politicians in matters of science. The defects of the qualities of science may be want of prudence and conciliation: the defects of the qualities of politicians are want of decision and certainty.

Decision and certainty are absolutely called for in matters like the maintenance of fisheries. There is no room for compromise with nature: knowledge of nature is not opinion, but definite and inevitable fact, and again we must insist that scientific men must be appointed to posts involving scientific training and knowledge in the conduct of the duties.

But scientific men are to blame in another fashion. Professions like the Law, the Church, or Medicine are close corporations or trade unions, which take vigorous action to support their members. Partly for the advantage of their members, partly for the advantage of Law, or Medicine, or Religion, they secure that every post shall be held by a suitable member of their own bodies: that the untrained and inexpert, whatever their general ability may be, shall not be appointed.

With us there is nothing corresponding. Here is a field for the British Association: to form a committee that shall be an advisory and consultative board on all matters affecting the interests of Science, and the interests of scientific men. It must be a committee elected by a body large enough and representative enough to convey the imperative judgment of Science, and strong enough to secure that its advice shall be acted upon. Our English Government is no autocrat that can disregard considerations presented to it by weighty authorities. If retired naval and military officers or mere

members of a party occupy posts that should be held by scientific men, not Government but scientific men are to blame.

GEOLOGY IN QUEENSLAND.

WE do not know whether it is that geologists are more united, or that geology, from its obvious connection with the Deluge, has had the public ear for a larger period than other branches of science that should come within the cognisance of the State, but the recognition of geology by the State has resulted in more active work in geology, both in England and in the colonies, than in any other branch of science.

We have received the *Annual Progress Report* of the Geological Survey of Queensland for the year 1893, by Mr. R. L. Jack, the Government Geologist. The work of the year appears to have been much interrupted by the disastrous floods, which took place at Brisbane during the month of February, and which might have irretrievably injured the collections had not prompt measures been taken by those on the spot, and had not the officers out in the field been summoned home by telegraph.

Since that time of trouble the offices and the collections of the Survey have been removed from their temporary home in Elizabeth Street to a more centrally placed building, recently occupied by the Registrar for Titles' Department. Here the collections have been rearranged and exhibited by the two energetic and able Assistant Geologists, Messrs. W. H. Rands and A. G. Maitland. The result of this moving, and the greater available space for exhibition, appears to have been to increase the popularity and therefore the usefulness of the Museum. Even at the somewhat inconvenient premises in Elizabeth Street, the collections were daily visited by about twenty-one people; the attendance has now greatly increased.

The exhibits in the Museum are arranged under the four heads of Maps, Minerals, Rocks, and Fossils. The productions of the colony itself naturally occupy a prominent place, and, subordinate to a broad scientific classification, they are arranged in accordance with their geographical position, beginning in each case with the northern-most representative. The rocks of Queensland are now completely exhibited for the first time. The arrangement of the fossils naturally follows that adopted in Messrs. Etheridge and Jack's excellent work on "The Geology and Palæontology of Queensland and New Guinea."

In a rising and imperfectly surveyed country such as Queensland the officers of a Geological Survey have naturally little time to spare for what we at home dignify by the title of pure science. They are bound to consider the immediate need of the community that pays them, and to devote their attention to the practical and commercial side of geology. In fulfilling this duty, the Geological Survey of Queensland, though miserably small in numbers, and though suffer-

ing from the financial whirlwind that lately swept over Australia, acquits itself right well. The most important work of this nature has been the survey of the well-known goldfield at Charters Towers. A geological map of the field, showing the surface outcrops, was issued early in the present year; since then the underground structure has been carefully investigated by all the available strength of the Survey, and a fresh edition of the map, embodying this work, will shortly be published. It is safe to say that this will now be the best surveyed goldfield in Australia, and that the detailed maps will be of enormous scientific and practical value.

In addition to actual surveying and collecting, the officers of such a Survey are continually being asked for information by prospectors, miners, agriculturists, and others. And in our colonies, it must be remembered, the officers of the State have to behave far more as the servants of the Public than some of them think it necessary to do at home. The Geological Survey of Queensland has recently received many enquiries as to water supply, especially as to the probabilities of finding it through artesian borings. Information is carefully collected and again retailed, which, we doubt not, greatly benefits the enquirer. But, as all who have had anything to do with water supply know well enough, it is an exceedingly difficult matter to advise upon, in the absence of very full and precise information as to the structure of the surrounding country. The circumstances may all point to the likelihood of an artesian well being successful, but an unperceived fault may disarrange the strata and prove the ruin of the whole attempt. Consequently, before a survey can be of that practical service to the community which is hoped and demanded, it is necessary that the whole country be adequately mapped in as great detail as possible. This, of course, is not a task to be undertaken in a hurry or by rule of thumb; it demands slow collection and collation of facts and prolonged scientific study. Many of the steps necessary for the successful accomplishment of the task are not such as appeal to the uninstructed public, which only regards immediate results. We refer especially to the collection and study of fossils, and the correlation of strata by their means. All this, however, must be done, and men and money must be supplied. The experience of all countries has shown that the investment is one that eventually pays a large interest, and we sincerely trust that, for the sake of the rich and beautiful colony of Queensland, every facility will speedily be given to its Geological Survey to continue the work so worthily begun by Mr. R. L. Jack and his devoted assistants.

The U.S. Geological Survey.

The September-October number of the *Journal of Geology*, just to hand, contains some observations by Professor R. D. Salisbury, *à propos* of the work of the United States Geological Survey, which are very

germane to our remarks on the Queensland Survey in the preceding paragraph.

It appears that additional appropriation has been made, providing for the gauging of the water supply of the United States, and for the investigation of the artesian water areas. This was by no means before it was required; for the information constantly demanded from the Survey, concerning the water resources of the country, is far more than it is at present in a position to give. Under Major Powell's administration an excellent beginning was made, but it was only a beginning, and by no means sufficient knowledge was obtained to enable the Survey to solve the various problems that are continually presented for solution. The mere fact that so many applications are made to the Survey shows that the American public is at last awaking to the fact that a knowledge of geology may save them many thousands of dollars.

The hydrographic work of a Survey must be based not only on geology and topography, but on meteorological records. The variation in rainfall on the one hand, and in barometric pressure on the other, are potent factors in determining the annual or seasonal yield of any given district. Meteorological information may no doubt be obtained from the already constituted Weather Bureau of the U.S. Government; but, as was pointed out in our review of W. B. Clarke's "Climatology of Maryland" (NATURAL SCIENCE, vol. v., p. 148), the climate of a country is itself largely dependent on its topography and geology. Thus the whole work falls most naturally into the charge of the Geological Survey. We learn from the *Journal of Geology* that "the organisation of the department of hydrographic work under the present limited appropriation is under the charge of Mr. F. H. Newell, who is assisted by Mr. Arthur Davis. Both of these gentlemen are trained topographers, and have had long experience in such hydrographic work as is contemplated by the Survey. At present they are largely engaged upon the special study of the water supply of the great arid and semi-arid regions of the interior, employing local assistance wherever parties are found who are interested in the work. A large amount of this assistance is voluntary, so that they are able to obtain much more extensive results than would otherwise be possible with the resources at command. The railroads, especially, are giving much assistance by having their bridge-tenders read the river gauges that have been set up under the direction of Mr. Newell."

Mr. Salisbury also informs his readers that the Director of the U.S. Geological Survey proposes to establish a laboratory for the study of materials used for road-making. This, it is believed, will give a great impulse to the improvement of highways throughout the land.

Hitherto much money has been wasted owing to the employment of inappropriate road-metal, which produced roads dusty in summer and muddy in winter. "Inferior materials have sometimes been used, when, in the immediate vicinity, there were other materials which,

alone or in combination, would have produced a solid road-bed." "A large part of the country, including the greater portion of the Southern States, and some portions of the Mississippi Basin, has been thought to be essentially destitute of materials suitable for the construction of good roads. The inquiries that have been made by geologists have shown that in many places within these regions there are hidden deposits of gravel and other sorts of rock, which, when properly used, might give excellent highways, and that around the margin of this great area, often within the limits of convenient railway distribution, there are abundant supplies of rock well fitted for such use. It only remains to discover the supply of such stone as is cheapest and best for the use of each region. . . . . For more detailed information, it is proposed that the various road commissioners send to the Survey samples of such rocks and gravels in their immediate vicinities as are believed to be valuable for road construction."

A laboratory in connection with the Massachusetts Road Commission has already been established at Harvard University. It is, however, not thought advisable that each State should establish a laboratory, for this would lead to much duplication of work, and after a time little work would remain to be done. Moreover, "the results obtained by divers observers and methods would lack the unity which give [*sic*] a national value." An officer of the Survey will therefore be detailed to take charge of the investigation of road-metal in the Harvard laboratory, and the establishment of a national laboratory will be brought to the attention of Congress, and a request made for a suitable appropriation.

As we firmly believe in the truth of the remark once made by a wise man, that the status of a nation's civilisation may be estimated by its facilities of communication within its own borders, so we cordially approve of these ideas of the new Director of the U.S. Geological Survey, and hope that in his attack on Congress he will meet with the success that his efforts deserve.

A Geological Record.

Although, in its relation to the State, geology is active and vigorous, yet it exhibits at present symptoms of neglect of a matter vital to the progress of scientific work. Rumours are rife that records of geological literature will soon be as dead as the Dodo, by reason of the difficulty of getting supporters in sufficient numbers to make such ventures pay. Talkers there are in plenty, and agitators for Records of new kind and arrangement; but few there be sufficiently interested in such work to put their hand into their pocket and keep a Record going. Dagincourt's "Annuaire" has made a good fight, has filled a great gap, but it is not supported as it should be. Blake's "Annals," too, dies from the non-support of those who clamour for Records. But during all the births and deaths of Records as individuals, there has yet been one that has

weathered the storm, and that solely because it has been supported by the very life-blood of our own Geological Society. Commenced many years ago as a quarterly list of books received, under the auspices of Thomas Rupert Jones, then secretary to the Society, it has gone steadily on, recording year by year the contents of every serial and the name of every book and map that has been received into the library. This year it may still be found by the curious in the November number of the *Quarterly Journal of the Geological Society* —ignored by nine-tenths of geologists, greatly prized by the remaining few. For of all lists published, these are the only ones where you may find a complete record of the geological papers in any particular serial for something like twenty years. It is not too much to say that this is the most valuable publication that the Geological Society gives to its members in the course of the year. The "Additions to the Library," for so it is called, has, we believe, been compiled by the present librarian, Mr. William Rupert Jones, for many years, though we have never observed his name attached to it. The list just published, which covers the period July, 1893—June, 1894, consisting of 125 pages, exceeds its predecessor in length by 45 pages, and is a remarkable example of careful and painstaking recording. We trust the Geological Society, whatever it may do in the matter of records, will keep this portion of their publications intact, for it serves a purpose which no other record has ever served, in giving a continuous account of the contents of various serials which is of considerable utility and value.

A Universal Zoological Record.

In this vital matter of recording, a most important step in advance comes from America, and Minneapolis has practically begun what should have been done by London, Naples, or Berlin many years ago. This means that we have received from Mr. Clarke Barrows, of the University of Minnesota, certain printed catalogue slips on cards of the well-known size supplied by the Library Bureau of Boston for card-catalogues. The arrangement of one of these slips is here reproduced:—

Wilson, Edmund B.

1892 July — The Cell-Lineage of Nereis. A Contribution to the Cytogeny of the Annelid Body. 7 plates, 8 wd.cts. & 1 cytogenetic table.

Journal of Morphology, Vol. VI, Nr. 3, pp. 361-460 (480).

Abstract in—

O ...[punched if required.]

These cards are samples of what is intended eventually to be a complete card-catalogue of zoological literature arranged under authors' names. The beginnings of the undertaking are, however, small. It is proposed to begin the catalogue with the current volumes of the periodicals now available at the University of Minnesota, which only number forty-two, whereas the actual number of periodicals containing zoological papers is not less than a thousand. But arrangements will soon be made to get the titles of all other important zoological writings, so that the catalogue will be complete for all zoological literature not recorded in Carus and Engelmann's Bibliotheca Zoologica up to the end of 1861.

The great feature of the proposal, however, is not the completeness of the catalogue, but the fact that these cards will be issued to all who choose to subscribe for them, at a rate not exceeding a penny a slip, thus furnishing them with a continuous and up-to-date reference to all zoological literature. The advantage of this plan over all other systems is that the list is always kept in alphabetical order; or slips can be selected and arranged in any other order that the purchaser desires. Let us make for a moment the very desirable supposition that the promoters of the *Zoological Record* will subscribe for a set of slips. Then the editor could at once roughly sort out the large majority of these slips and hand them over to the recorders of the different groups. The remaining doubtful slips could be gone through by the editor or any competent zoologist with the aid of the original publications, and could thus be sorted according to the group or groups with which they dealt; duplicates could of course be purchased when required. By this simple means each recorder would be furnished at the start with his list of titles, and whether the list were complete or not it would at all events be known that it was complete for certain periodicals. Each recorder would thus have to refer only to the papers in his list, and would be spared the drudgery of wading through piles of profitless publications. Librarians also will be glad to be spared the trouble that authors' copies are continually giving them, since their subscription will get for them not merely the reference, but a slip all ready to insert in their card-catalogue. In short, this enterprise may do much to remedy the sad state of things described in the vigorous article by Mr. Stebbing contributed to our last number; and we venture to think it superior to the proposals that Mr. Stebbing has put forward there.

There is nothing very new in this plan. Similar suggestions were made in the correspondence columns of *Nature* during August and September, 1892, while on the continent Dr. H. H. Field seems to spend most of his time in advocating the establishment of a central zoological bureau to perform this very work.[1] The only thing that is new, and that is really astonishing, is that someone has at last made a beginning. We may for various reasons regret that

[1] See *Mém. Soc. Zool. France*, vii., p. 259: 1894.

it has been left to Minneapolis to show us the way, and we could wish that the headquarters of the movement had been in a city where there were a few more zoological publications than are to be found in the library of Minnesota University. But we must rejoice that the admirable methods of library cataloguing which have been brought to such perfection by the Americans are at length to be applied to the relief of the overweighted zoologist, and we must hope and strive that sufficient pecuniary support be forthcoming. If the undertaking be once fairly started, and if it acquire those proportions that are needed to make it really valuable, then we shall soon be wondering how on earth we ever managed to get along without its assistance. Those, and we trust they are many, who desire to aid this good work, should communicate with Mr. Clarke Barrows or Professor H. F. Nachtrieb at the University of Minnesota, Minneapolis, U.S.A.

THE LINNEAN SOCIETY'S CATALOGUE.

THERE is not a wide difference between Records of Literature and Catalogues of Libraries, and while we are on this subject we may well consider the strange case of the Linnean Society. For many years past, successive Councils of that learned body have struggled with the apparently hopeless task of bringing out a list of their books that shall supplant the old catalogue of 1866. Such a work should take certainly not more than one year to accomplish, but although there have been many rumours of its incubation, nothing has as yet appeared. We say "appeared" advisedly, because we have ourselves seen an abortive pamphlet which purported to be an attempt at a catalogue of the serials, but, so far as is known, that has never been distributed or sold by the Society. Surely years enough have passed since the publication of the last catalogue to make it worth the while of the Council to publish another, for the library contains an interesting series of books quite apart from the precious volumes which at one time formed part of the library of Linnæus himself, and many of which are almost if not quite unique in this country.

It may be urged in excuse that the officials of such a Society have enough to do to carry on its regular business, but there are many men who would be perfectly competent to make a catalogue, and who would be glad of such congenial occupation. It is curious how apathetic ordinary members of societies are: they are content with the pride of membership and with the idling of an occasional evening; so long as tea and coffee are served they do not care one jot what happens with regard to the general management. But surely there must be many members of the Linnean who are sufficiently alive to the importance of knowing what the resources of their library are, and it is surprising that they do not insist on a catalogue being published.

Possibly by the next anniversary meeting (May 24, 1895), some Fellow may be goaded into asking for what may be an explanation

but can be no excuse. In the meantime, it would be quite possible to make a catalogue. The members of such a Society as the Linnean, with a historic past, should regard themselves as trustees for the hopes of the original founders, and they should remember that it is their imperative duty to maintain and improve the body corporate.

Science and Medicine.

Sir James Paget and Dr. Lauder Brunton.

The reproach of empiricism is being removed from medicine at a rate which would have startled the medical mind of only twenty years ago. It is true, indeed, that no amount of scientific knowledge can replace clinical experience, but it is to the combination of the two that we must look if we are in search of the ideal practitioner. Every scientific man will welcome the tone of the inaugural address delivered by Sir James Paget before the Abernethian Society, at St. Bartholomew's Hospital, on October 11. That a man cannot be at once a scientific man and a good practitioner was characterised by Sir James as sheer nonsense, and he proceeded to show in how many ways the science of medicine could be advanced, even by a busy man in general practice, if he were possessed of a truly scientific mind. He emphasised also the importance of the collection of facts, verified again and again till they were absolutely certain. In all that he said we most heartily concur. Few applied sciences are so complex as that of medicine, and in none is there need of more close and accurate observation. This power is to be attained only by scientific training, and it is to the superior education in science now afforded to the medical student that much of our recent advance is due, while still more may be looked for in the future. No better maxim can be taken as a guide in science than the sentence of John Hunter's quoted by Sir James Paget: "Do not think: try: be patient: be accurate."

If further commentary on Sir James Paget's address be needed, it may be found in Dr. Lauder Brunton's Harveian Oration, delivered a few days later before the Royal College of Physicians. The one man above all others from whose discoveries modern medicine may be said to date is undoubtedly Harvey: and Harvey was a practical physician no less than a brilliant investigator. This year's Harveian Orator is himself an example of the same combination, and in bestowing the Moxon medal for clinical research upon Sir William Jenner, the College of Physicians has shown its recognition of the high value to be set on the results of scientific method in the hands of a busy practical man.

There is, however, another side of the matter. Every practitioner may be and should be a scientific man, but it is not by the labours of the practitioner alone that modern medicine has advanced. Of this fact Dr. Brunton's Harveian Oration affords many instances He devoted the major part of his time to a consideration of the

modern developments of Harvey's work, and here it is to be observed that the pure physiologist is to the front. The specialisation demanded by modern science renders this imperative, and all that can be asked of the practitioner is that he shall keep himself abreast of the discoveries of the physiologist and learn to apply them in the treatment of disease. It is the intelligent application of the discoveries of pure science which forms the field in which clinical medicine and surgery have made and will make their most rapid advances, and it is in this field that a scientific training and habit of mind will be of most value to the practitioner.

ANTITOXINS.

THE latest application of pure science to practical medicine consists in so-called "serum therapeutics." Although diphtheria antitoxin is still on trial as a means of practical treatment, there can be no doubt that its discovery is an immense advance in medicine. Chemical theories of immunity now bid fair to oust from the field the theories based on the doctrine of phagocytosis. "Für böse Gifte, Gegengift," sings Brangäve, in 'Tristan und Isolde,' and it is a good motto for the modern pathologist. There is already strong evidence that the 'Gegengift,' manufactured in the animal body as the result of a non-fatal attack of tetanus or diphtheria, can be used with effect in the treatment of the same diseases in man; but some time must elapse before good statistical evidence is forthcoming as to the effects of the diphtheria antitoxin. And for this reason. It is a usual custom in this country to regard as diphtheria all cases of membranous sore throat, nor can it be doubted that it is a wise practice to treat them as such. But statistics are in this way largely invalidated. Conclusive proof of the diphtheritic nature of a sore throat can be obtained only by the recognition of the characteristic diphtheria bacillus, and it is, perhaps, chiefly on this account that the foreign statistics of diphtheria mortality appear so much higher than ours, since only cases in which this evidence is present are admitted into the category of true diphtheria. When this source of fallacy is removed in this country by a systematic bacteriological examination of all cases of suspected diphtheria, we shall be in a position to estimate at its true value this latest development of science in the treatment of a hitherto intractable disease.

AN ELECTRICAL THEORY OF VISION.

AN interesting communication, brought before the British Association, and as yet unnoticed in our columns, was Professor O. J. Lodge's suggested electrical theory of vision. This was preceded and introduced by experiments illustrating Clerk Maxwell's theory of light. The necessary electrical radiations were obtained from a sphere charged from an induction coil; for their detection an arrangement of loosely-packed particles was employed. These, under the influence of the surgings of the electrical radiations, attracted one

another, and so became more closely packed. When closely packed they allowed a current to pass through more readily. The arrangement is termed a "coherer," on account of the capacity of the constituent particles to become more closely packed. After coherence the original looseness and consequent resistance may be restored by tapping. Professor Lodge's "coherer" consisted of iron borings loosely placed in a glass tube. The glass tube was placed in a large copper "hat" to protect it from electrical influences other than the radiations. The radiator was cased so that its radiations were directed to the coherer, and the coherer was read by a reflecting galvanometer with which it was placed in circuit.

With these appliances there were shown :—The influence of the radiations on the conducting power of the coherer; the polarisation of the radiations by gratings of parallel copper wires, the vibrations in the direction of the length of the wires being arrested, the others passing on; the reflection of the radiations from bright metal surfaces, from wood, and from the human body; the transparency of glass to these radiations, and the refraction of the radiations by means of a prism of paraffin: all indicating the analogy of these radiations to those of light.

From such experiments came Professor Lodge's theory of vision, which, however, he put forward as the suggestion of a theory rather than its promulgation. Briefly put, his suggestion is that light may excite transverse vibrations in the rods and cones of the retina, that these vibrations may alter the resistance of some part of the eye and so cause the recording of the light stimulus, and that the stimulus corresponding to the process of tapping for restoring the coherer to its original state would be the influence of darkness. Between the stimulus of light and that of darkness there would be persistence of vision. These ideas were illustrated by means of the coherer, the restorative tapping being effected automatically through vanes revolving by clockwork.

In the subsequent discussion, Lord Rayleigh insisted on the necessity of the three-fold nature of colour-vision being taken into account in any theory of vision; Professors Armstrong and Fitzgerald naturally laid stress upon the physico-chemical side of vision and the resemblance of the retina to a sensitised plate; while Professors Rutherford and Schaefer discussed the anatomical structure of the eye as a coherer. But Professor Burdon Sanderson made what, in our view, was at once the most obvious and the most valuable criticism, when he pointed out that, while Professor Lodge's suggestion was worthy of consideration as a theory of the action of light upon the retina, it was not a theory of vision at all.

Mind and Body.

The point raised by Dr. Burdon Sanderson in connection with Professor Lodge's suggested theory of vision raises the perennial difficulty

of mind and body. In the question of vision this difficulty is strikingly obvious. We can see that light has a direct effect upon the protoplasm of many of the simplest animals and plants. Many single-celled forms of life, imprisoned in a vessel, darkened, for instance, by being covered with black paper except at one spot, will crowd towards the window of light; others will shun the light and assemble in the darkest regions. In many of them, again, when they are observed under the microscope by a beam of light reflected through them by the mirror of the microscope, the direct effect of light as a stimulus may be seen by their sudden movements when the mirror is flashed on them or turned off. From conditions so simple up to the complicated eye of the mammalia an infinite number of grades of complication in the arrangement of cells, specialised in the direction of sensitiveness to light, may be observed, while, again, there are similar series of grades of elaboration of accessory structures. Thus there are structures that seem to be mechanisms directly optical, like convex transparent lenses and corneas to focus the beams; curtains of pigment, perhaps corresponding to the velvet sheet of the photographer; pigments that are directly affected by the chemical action of the light, like the sensitised film of a photographic plate.

Some of these arrangements are fairly well understood; about the function and mechanism of others theories are numerous and divergent. But were they all understood, not vision, but the mechanism of vision, would be understood. The appreciation by the brain or by the mind of the sensational stimuli afforded it by the optical apparatus involves many things that are not optical. It involves memories of previous visions, memories of touch, memories of movements, and several other factors. The analysis of what we know as sight, and the correlation of the component elements with the results of chemical, physical, and physiological investigation of the eye, is one of the obscurest tasks of the psychologist.

REALISM IN ART.

As an obvious example of the difficulties attending the phenomena of vision, consider the dispute in art connected with what is called realism. We may dismiss, first of all, idealised compositions, pictures in which the imagination of the artist frankly transforms his impressions of Nature. Take three types of paintings or drawings, each of which are set forward by some and accepted by many as adequate representations of what may actually be seen. To the first of the three types belong the landscapes of Mr. Waller Paton, scenic arrangements like Mr. Frith's celebrated "Derby Day," or the later works of Sir John Millais. Round such as these one may notice a group of admirers crying, "See, it is Nature itself! Look at the sheep on the distant hill with their owner's initial in red paint on their fleeces, while on the grass-blades in the foreground behold here

a beetle, there a caterpillar crawling." To the second type belong the striking productions of the modern impressionists; to many these appear chaotic daubs; an increasing number of people believe that the impressionists alone have the secret of producing by their canvases the same impressions that Nature produces. The third type, which is that most astonishing to the Western mind, consists of the strange Art of China and Japan, an Art so incongruous with our ideals that, at the first seeing, we hold it a fantastic perversion of the real. Yet these yellow artists would say "lying prone on the ground we draw things as we see them, and the lines and marks of our patient brushes show our brothers what we have seen."

Leaving aside all questions of art and technique, it is plain that the same things appear in different ways to different men, and to different races of men. Some of these differences may depend upon difference in structure of the optical apparatus, and so may have a physical explanation; many of them seem more likely to depend upon differences in mind or brain, and are matters for the psychologist.

Physiological Apparatus for Plants.

Workers in plant-physiology will find a description of several new and useful pieces of apparatus in a recent number of the "Minnesota Botanical Studies" (Bulletin no. 9, part iv.), a publication of the Geological and Natural History Survey of Minnesota. The first, devised by A. P. Anderson, is a balance with a self-registering mechanism for recording the rate of transpiration and its periodicity (if any) during a certain time. It consists of a balance, one arm of the beam of which is lowered by the increase in weight of a calcium chloride absorber. The lowering of the arm closes a circuit, and an electro-magnetic mechanism releases a weight which falls into the scale-pan attached to the other arm. The scale is thus balanced automatically after an increase equal to the weight used has taken place. At the instant the weight is released it is recorded on the registering cylinder of a recorder. The whole is enclosed in a case, for protection from falling moisture.

A new electrical auxanometer and a continuous recorder are described by W. D. Frost. The former was devised for such delicate measurements as of growth in thickness of stems and fruits, but is equally efficient in measuring growth in length, while its extreme lightness and delicacy make it especially useful in measuring the growth of small plants. The frame-work of it is made of aluminium, and the whole instrument weighs fifteen grams. For measuring growth in thickness it may be attached to the plant, increase in size of which unwinds a thread from a pulley, while the turning of the latter, by means of a ratchet-wheel, alternately opens and closes an electric current. The recorder and the auxanometer may be

separated any distance, and the former may also be used with other pieces of apparatus where a continuous record is desired.

The Discoverer of Dionæa.

In the *Journal of Botany* for November the editor gives some account of William Young, an American adventurer of the last century, who first brought to England, in 1768, living specimens of *Dionæa*, the carnivorous plant commonly known as Venus' fly-trap.

Young seems to have been a pushing, uneducated man, who, by dint of impudent self-assertion, got himself appointed Botanist to their Majesties, in 1764, much to the disgust and surprise of honest folk, like John Bartram and others, who knew him at home in Philadelphia. Apparently his only other claim to distinction rests in a MS. volume containing about three hundred rude figures of plants, and a corresponding volume of specimens, both now in the Botanical Department of the British Museum.

Change of Address.

We beg again to draw the attention of our readers to the notice that appears under the above heading on the last page of the present number. It is hoped that the new arrangement, which will come in force with the new year, will have the effect of facilitating our own business and our dealings with the public by concentrating the Editorial, Printing, and Publishing Offices at one address, instead of distributing them among three as has hitherto been the case. It was well at first to place ourselves in the kindly hands of so well-known a firm as Messrs. Macmillan, and we should like to take this opportunity of thanking them for the assistance and courtesy that they have extended to us. But now that we are growing up and begin to feel our legs, we are bold enough to think that we can walk alone. Whether we can succeed or not must of course depend not on ourselves but on the number of hands stretched out to help us. Since the Review will still be conducted by the same editorial staff and on the same lines as heretofore, we appeal confidently to our readers, subscribers, and contributors not to desert us; indeed, we venture to hope that they will now aid us all the more both in purse and person. If only their sympathy be assured, we shall step from the cradle with a light heart.

I.

The Homes and Migrations of the earliest known Forms of Animal Life, as indicated by Recent Researches.[1]

THERE is no portion of the geological record more important to the biologist than that which contains the history of the earliest known forms of animal life, for whether he believes in the theory of evolution or not, he is there made to see that there is a remarkable similarity in the forms which constitute the earliest faunas wherever they have been discovered. In speaking generally of these faunas we do not, of course, mean that similar marine animals occurred in each area at the same exact period in the world's history; on the contrary, if we admit that the animals migrated then as now when the conditions were favourable or otherwise, such would be impossible; but what is meant is that they occupy in the geological succession relatively the same general position. For instance, where the faunas, which we may here call A, B, and C, are found in conformable strata, the order of their appearance is the same in each area. If the sections have been correctly interpreted, C has in no case been found to precede A, nor B to succeed C. Year by year we have been made acquainted with fresh discoveries among the older rocks, but whether the evidence comes from Australia, China, India, Europe or America the fact remains that the order of the appearance of certain forms of animal life in the succession does not vary from that which had previously been made out in other areas. In the most favoured areas the rocks can only be expected to contain a very imperfect history of the animal life which existed at the time when they were deposited; still, sufficient evidence has been obtained to make it easy to realise what were the dominant forms prevailing at the time. For instance, it is well known that the earliest faunas are everywhere characterised by having Trilobites as their dominant organisms, and further that each fauna is distinguished by well-recognised genera with a comparatively limited vertical range. As the earliest faunas of which we have any knowledge contain well-developed forms belonging to widely separated groups, it is clear that we are here far from the beginning of life on the globe. How is it then that, with all

[1] Read at the meeting of the British Association, Oxford, 1894.

the careful researches which have been made of late years, no well-recognised forms have been discovered in earlier rocks than the Cambrian?[2] Certainly, only a few sediments have yet been discovered of earlier date than the Cambrian which could have been deposited under conditions suitable to the existence of animal life; but some have been found, and yet up to the present they have only yielded very doubtful traces of organisms. The great physical changes which affected a very large surface of the globe before the Cambrian rocks were deposited possibly removed or obliterated much important evidence; but on the other hand it is more than probable that sediments containing many earlier faunas than those at present known to us are now submerged in the great oceanic basins.

It is generally admitted by geologists that the ocean basins have been great depressions of the earth's surface from a very early period in the world's history, but this does not of course mean that the same amount of land has been under water from that time to this. We know, on the contrary, by geological evidence that, owing to repeated physical changes, the area covered by water has varied much in extent at different times from the Cambrian period to the present; and it seems but reasonable to suppose that it did so also in Pre-Cambrian times. These changes, however, have been mainly along the borders of the oceans; hence the strata which have been brought to the surface are all comparatively shallow-water deposits. From what has been stated it would be anticipated that the earliest known faunas would be likely to have a fairly wide distribution over the globe, and that they would contain such forms only as could live near shores or in comparatively shallow water and were not easily affected by changes of temperature.

If the earliest known faunas lived along the borders of the ocean basins, it is but natural to suppose that pre-existing faunas, from which they were descended, inhabited similar localities; and we are justified in supposing that these basins when first tenanted by animal life were very much more limited in extent than they were at the commencement of Cambrian time. The lowest Cambrian rocks, being everywhere deposited near shore or in comparatively shallow water, tell us clearly that the depression at that time was still going on, and that the waters were spreading gradually over fresh land-areas. Most of the evidence obtained of late years bearing on these questions has been accumulated through researches in Europe and North America; therefore I propose to confine my further remarks to those portions of the globe.

As the surfaces of the Pre-Cambrian continents of Europe and America were very irregular when the lowest Cambrian deposits

[2] The paper by Professor W. K. Brooks, of which an account was given in the October number of NATURAL SCIENCE (vol. v., p. 242), deals with this question in a very interesting and nighly suggestive manner, and seems to me to explain some of the difficulties which meet the palæontologist in his inquiries.

were thrown down, it is only to be expected that the Cambrian rocks should vary considerably in importance in different areas, and therefore that the faunas also in some areas should be but poorly represented. Those parts which would be first encroached upon, if the depression was very gradual, as we have every reason to think it was, would contain the best record of the succession of life; and all recent researches have tended to show that the Cambrian faunas in the areas bordering the North Atlantic basin are the richest in the number of genera and species, and therefore contain the most perfect record of the succession of life in the early rocks hitherto obtained.

In a paper communicated to the Geological Society in 1875,[3] which referred mainly to the European areas, I stated that "the first fauna of which we have any knowledge occurs in the beds furthest to the west, and there in earlier beds than any which occur in the regions more to the east; and though the forms which make up this fauna belong to inferior classes, yet they are not the lowest types in those classes, but often show evidences of considerable progression in development. On this account I have often expressed the opinion that we were far from the beginning of this type of life even in the earliest Cambrian faunas, and that the forms had already undergone many changes previous to this period. It is easy now to see how these changes could have taken place, and moreover how it was that new forms so frequently appeared at certain stages highly developed and with no previous evidence in the rocks as to the changes they had undergone. The home of the earliest forms of life seems to have been somewhere towards the south-west, and possibly not far from the equator; and it is from here that the various forms seem to have migrated to the areas in which they were subsequently entombed. The migrations seem to have taken place towards the North-American continent very much about the same time as towards the European; and the sea-encroachments along that continent seem to have been in a direction from south-east to north-west, so that the lines indicating the two depressions would meet in mid-Atlantic. This accounts for the great similarity in the two faunas, and for the general resemblance offered by the order of succession of these early rocks in the two continents. The higher lands in America would be to the west and north-west, and the higher lands in Europe to the east and north-east; so that the last lands submerged would approach each other and occupy the same region of the globe."

When the above remarks were written, forms belonging to eight classes had been discovered by us in the Lower Cambrian (now called Lower and Middle Cambrian) in Wales; and in a paper in the *Quarterly Journal of the Geological Society* (vol. xxviii., p. 173, 1872) I stated that: "These same groups are also more or less present and tend to characterise these early deposits wherever

[3] *Quart. Journ. Geol. Soc.*, vol. xxxi., p. 552.

found; but no country has up to the present time produced a more varied fauna or a greater richness in types than England. Scandinavia has a larger number of species, but not so many groups." The classes at that time represented in the Cambrian rocks of South Wales were the following, viz., Spongida, Echinodermata, Annelida, Brachiopoda, Gasteropoda, Pteropoda, Crustacea, Trilobita. In the table, in the paper above referred to, seven classes only are mentioned; but since then it has been shown that the genus *Stenotheca*, which I had previously discovered in the Menevian rocks at St. David's, should be classed with the Gasteropoda.

Mr. C. D. Walcott, Director of the United States Geological Survey, in his very important memoirs, "The Fauna of the Lower Cambrian or Olenellus Zone,"[4] and "Correlation Papers, Cambrian,"[5] makes careful comparisons of the rocks on both sides of the Atlantic, which contain the Cambrian faunas, and says that "in lithologic, stratigraphic, and palæontologic characters, the Cambrian series on the opposite sides of the Atlantic are such that there is no hesitancy in considering them as belonging to one geologic group and as part of one geologic basin."[6] He further points out that the Lower Cambrian fauna, which he regards as a littoral fauna, is much more persistent in its character than that in the succeeding rocks, "for all the strata referred to the former horizon have been found to be characterised by essentially the same fauna." The Lower Cambrian fauna in America, according to Mr. Walcott, contains genera belonging to the following classes of invertebrate animals, viz., Spongida (4 genera), Hydrozoa (2 genera), Actinozoa (5 genera), Echinodermata (1 genus), Annelida (4 genera), Brachiopoda (10 genera), Lamellibranchiata (3 genera), Gasteropoda (6 genera), Pteropoda (4 genera), Crustacea (5 genera), Trilobita (15 genera).

Mr. Walcott's list contains a larger number of classes and of genera and species than is at present known in the Lower Cambrian fauna on this side of the Atlantic; but, with the exception of the Lamellibranchiata, all the classes are now known to occur in the Middle Cambrian either of Wales or Scandinavia. It will be seen that Trilobita and Brachiopoda are the dominant classes, and this is equally marked in the succeeding or Middle Cambrian fauna. The Trilobita, especially, give to these faunas their very distinctive characters, and the faunas are frequently referred to as the *Olenellus*, *Paradoxides*, and *Olenus* Zones after closely-allied genera, which also are the most typical occurring in them. The genus *Olenellus* occurs only in the Lower Cambrian, *Paradoxides* in the Middle Cambrian, and *Olenus* in the Upper Cambrian. The order in which they appear in the succession is the same wherever they have been discovered in all the American and European sections.

[4] Tenth *Ann. Rep. U.S. Geol. Survey*, part i., pp. 509–763, pls. 49–98: 1890.

[5] *Bull. U.S. Geol. Survey*, no. 81: 1891.

[6] *Op. cit. ult.*, p. 372.

It is a tempting field for speculation to enquire why this should be the case. It has been suggested that *Olenellus* was a form peculiarly adapted for living in shallow water and along shore-lines; *Paradoxides*, on the other hand, is a much larger form, and would require somewhat deeper and more open water. It is the dominant form in the Middle Cambrian, and attained to a size of over twenty inches in length, being the largest trilobite known. When the Middle Cambrian rocks were deposited, a considerable depression had taken place, and though the depth was not great, the sediments must have been deposited in a fairly open sea. *Olenus*, the typical genus of the Upper Cambrian, was of small size, and has the appearance of a degraded form of *Paradoxides*.

When I ventured to suggest that the "home of the earliest form of life seems to have been somewhere towards the south-west, and possibly not far from the equator,"[7] I was, of course, referring specially to the North Atlantic Ocean. The other oceans would doubtless be equally tenanted by life, and would form centres of dispersion. In these early oceans there would, of necessity, be forms of life suitable to the varying depths; but it is not to be expected that representatives of all these could occur in any of the earliest faunas with which we are acquainted. When deeper water faunas are found in the succession, there, as in the littoral faunas of the early Cambrian, abundant appropriate organisms suddenly appear, showing that they had occupied areas favourable to their existence contemporaneously with the earlier faunas entombed in shallow-water deposits. As an instance of this we may mention the sudden incoming of the very rich graptolite fauna of the Arenig rocks.

HENRY HICKS.

[7] *Quart. Journ. Geol. Soc.*, vol. xxxi., p. 555.

II.

Cephalopod Beginnings.

THE chief object of this article is to draw attention to some observations recently made in North America by Mr. J. M. Clarke of Albany, and published in the *American Geologist* (6, 7, 8); to make in passing such criticisms as may seem desirable; and to consider the relation of the new facts to the general question of Cephalopod evolution.

First, however, for the sake of those whose studies have not lain specially among the Cephalopoda, it may be advisable to explain a few of the terms employed.

The shell of a typical cephalopod, such as *Nautilus*, *Ammonites*, or *Orthoceras*, consists of a very elongate cone, which may be straight or curved or coiled, but which is always divided interiorly by transverse partitions, or 'septa,' into a number of chambers, or 'loculi.' Broadly speaking, these loculi gradually increase in size from the apex of the cone towards its aperture, not merely because the width of the cone increases, but because the septa are placed at a gradually increasing distance from one another. The shell, as thus described, may be called the 'conch' or the 'phragmacone,' the latter word meaning nothing more than septate cone. The soft body of the animal is lodged in the wide end of the shell, in front of the last-formed septum; and the cup-like space in which it lies is called the 'body-chamber.' That part of the body which abuts on the last-formed septum and which fills the bottom or hinder part of the body-chamber, contains the chief viscera of the animal, especially the generative glands, and is known as the 'visceral hump.' This hump is covered with a thin, glandular skin, which secretes membranes of an organic substance called 'conchiolin'; as these membranes become impregnated with lime (calcified), the septa and the inner lining of the shell-wall are thus formed. The formation of septa in the cephalopod shell is precisely parallel to the formation of septa in other molluscs and in other groups of animals, such as the tabulate corals; that is to say, the soft body with its posterior secreting surface moves forward at intervals in its cone or tube. As to the causes of this forward movement there has been much speculation, into which it is now unnecessary to enter. One thing, however, seems fairly clear, namely, that the formation of

regular septa was a gradual development from a primitive non-septate condition.

A peculiarity that distinguishes the septate cephalopod shell from the septate shells or tubes of most of the other animals above alluded to, is the fact that an extension from the soft body always passes backwards through the septa and, however long the phragmacone may be, always appears to maintain connection with its apex. In such a form as the modern *Nautilus*, this extension comes off sharply from the visceral hump in the form of a thin tube, which passes immediately through the centre of the last-formed septum and stretches back through the loculi and through the centres of all the preceding septa. This fleshy tube is known as the 'siphuncle.' It will, however, be noticed that, just before the siphuncle becomes attached to the visceral hump, that is to say just where it passes through the last septum, it enlarges slightly, so that between the visceral hump and the siphuncle proper there is a small cone, which contains a slight extension of the generative viscera, and which may therefore be distinguished as the 'visceral cone.' Were all cephalopods fashioned like *Nautilus* in this respect, there would be no need to use this term 'visceral cone'; but there are many in which the visceral cone assumes very large proportions and appears to have given rise to some misunderstanding in the minds of those who have described such cephalopods. If we define the visceral cone as that part of the soft body which lies posteriorly to the inner margin of the last-formed septum, but anteriorly to the narrow siphuncle, we shall at once render futile many discussions that have taken place, as, for instance, those concerning the presence or absence of a siphuncle in *Sepia*, and we shall have a ready explanation for many puzzling structures in archaic cephalopods, such as the 'sheaths' and absurdly named 'endosiphon' of *Piloceras* and *Endoceras*. These, however, are details rather foreign to the present purpose. It is enough to point out that, whereas the siphuncle proper does not secrete a definite shell and merely becomes impregnated to a slight extent with carbonate of lime, the visceral cone, on the contrary, retains to a very large extent, in many cases, the typical secretive power of the visceral hump, by which shell-substance is eventually formed.

Having considered the phragmacone, or conical-chambered conch, in sufficient detail for the object of this paper, we turn now to a structure to which, under Owen's name of 'protoconch,' much attention has of late years been directed. Examination of the phragmacone of *Spirula*, of *Belemnites*, or of any ammonite or, better, of such a loosely coiled goniatite as *Mimoceras compressum*, will show that at the apex of the cone, which of course lies in the centre when the shell is coiled, there is a little round bulb, usually separated from the conch by a slight constriction (compare Figg. 1, *a* and 2, *b*). The siphuncle passes through the end of the conch into the protoconch; but instead of retaining its simple tubular character, it generally

enlarges within the protoconch into a rounded swelling, which is not attached to the wall of the protoconch. In *Nautilus* the apex of the conch is well known to be of a different nature. There is no rounded protoconch attached to the end of the cone, but the outer wall of the first loculus is marked by an elongate scar, the 'cicatrix,' which is at a little distance from the actual apex and on the inner side of the coil. Correlated with the absence of the globular protoconch, there is always a passage left between the inner side of the first loculus and the succeeding whorl of the shell. In other words, the umbilicus is perforate; whereas in the closely coiled ammonites this space is entirely filled by the protoconch. Round the cicatrix the shell is perceptibly thicker, and forms a raised margin to it. Within the first loculus, the siphuncle is tubular and cylindrical, and is attached to the wall of the conch almost, though not exactly, opposite the spot where the cicatrix lies externally.

When attention had once been directed to this distinction between the protoconch-bearing shells of the Ammonoidea and of the forms allied to *Belemnites* and *Spirula*, on the one hand, and the simple conchs of the Nautiloidea, on the other hand, it was supposed by many eminent writers, such as Barrande and Branco, that an insuperable distinction had been found between the Nautiloidea and the Ammonoidea; and Barrande especially, with his anti-evolutionist opinions, was delighted to prove, as he thought, that the ammonites could not possibly be derived from the nautiloids. So far was this distinction pushed by some, and notably by that ingenious thinker Munier-Chalmas, that the ammonites, goniatites, and their allies were bodily transferred from their position with the Tetrabranchiata of Owen's classification to the opposite division, namely the Dibranchiata.[1] Others, of whom Waagen (16), though with some hesitation, was the first, have adopted the simpler and the safer course of doing away with the classification of Owen, which, so far as it applied to fossils, was based on characters of which we knew and for ever shall know nothing, and of substituting therefor a division into three Orders, based chiefly on the structure and relations of the shell. These three orders are (i) the Nautiloidea, (ii) the Ammonoidea, (iii) an order equivalent to the Dibranchiata of Owen, for which I have proposed the name Coleoidea (1, 2), but for which others have adopted the (as it seems to me) less appropriate and rather misleading name of Belemnoidea (15, 4.)

It would be going too far afield to consider the very remarkable views as to the relations of the Octopoda that are held by Steinmann (15), or the modifications of Steinmann's classification recently proposed by Schwarz (13). The observations of Hyatt concern us more closely. This suggestive writer maintained some time since (11), on the evidence of specimens from St. Cassian preserved in the

[1] See for instance Bernard's "Eléments de Paléontologie," reviewed in NATURAL SCIENCE, vol. v., p. 298; October, 1894.

British Museum, that two species of *Orthoceras* (a genus universally ascribed to the Nautiloidea) did indeed possess very visible traces of a protoconch in the form of shrivelled masses of calcareous matter, which overlaid and obscured the cicatrix. The shrivelling was supposed by Hyatt to indicate that the protoconch in these forms was only slightly calcified, that, in short, it was chiefly formed of conchiolin. This would similarly account for its destruction in so many individual cases, and for its final complete disappearance in the subsequent history of the Nautiloidea. Upon this theory the gap assumed by Branco and Barrande to exist between Ammonoidea and Nautiloidea was to a certain extent bridged. "There is," wrote Hyatt, "convincing evidence in the structures of [certain] Cambrian shells that the Ammonoidea, with their distinct embryos, arose from the orthoceran stock, and passed through a series of forms, in times, perhaps, preceding the Cambrian, which were parallel to those characteristic of genetic series among Nautiloidea, viz., straight, arcuate, gyroceran, and nautilian." Six years later, in his magnificent monograph on the Genesis of the Arietidæ (12), Hyatt considered that the accumulated evidence had become yet more convincing; one observation of special importance was that the longitudinal striæ, which are so characteristic of many young nautiloids, were believed to pass from the conch itself onto the surface of the shrivelled mass which Hyatt claimed to be the protoconch.

Now, since so much stress has been laid, by Hyatt and others, on these observations, it behoves us to consider them with great attention. Fortunately the critical specimens are preserved in the British Museum, so that it has been possible for my colleague, Mr. G. C. Crick, and myself to subject them to a prolonged examination with the aid of the microscope. I am compelled, before proceeding with this article, to formulate our conclusions, which have reference to the figures on page 10 of "The Genesis of the Arietidæ":—

Figures 1–3. This specimen shows absolutely no trace of longitudinal striæ; therefore it is impossible for longitudinal striæ to pass onto the so-called protoconch, a statement based solely on the evidence of this specimen. On the other hand, it shows distinct traces of concentric striæ, which would doubtless have been more distinct had the specimen not been rolled and rubbed. There is no great distinction in colour or texture between the so-called protoconch and the rest of the shell. There are, however, clear signs that the shell has been flaked off from the end, and it seems perfectly possible that it once extended over the so-called protoconch. There is absolutely no evidence that the supposed shrivelled remains of the protoconch rest upon the cicatrix, or that they extend over the apical plate; on the contrary all the appearances suggest that this wrinkled mass passes up from inside the cicatrix, and that it is merely a plug, or infilling of secondary calcite deposited within the shell during the life of the animal.

Figures 4 and 5 are more correct, but the distinctness of the protoconch is certainly exaggerated. There is, indeed, a slight constriction, but there is no sign of shrivelling.

Figures 6, 7, and 8. This specimen shows no definite protoconch and hardly a trace of constriction. There is an abrasion of the surface, as shown in Fig. 7, but the shrivelling is greatly exaggerated. The outline of Fig. 6 is correct, and shows a slight swelling a little distance from the apex.

In short, we see no essential differences between these specimens and that represented in Figures 18 and 19, in which the protoconch is said by Hyatt to be removed and the opening to be plugged by secondary calcite, and which is actually figured for the sake of contrast with the specimens said to retain the protoconch. In making these criticisms, which are based on independent observation, we have the advantage of following the opinion of the great palæontologist, Barrande.

It does not follow from the preceding remarks that the species of *Orthoceras* in question (assuming that they do belong to that genus) were unprovided with protoconchs at some period of their lives; nor does it follow that the little lump seen at the ends of the specimens in the British Museum may not be some representative of a protoconch. It may very well be the calcareous infilling of a thin-walled protoconch; but there is no reason for regarding it as the shrivelled remains of a conchiolinous shell.

If therefore the general conclusions of Hyatt were to be accepted, it became desirable that some concrete instances should be found, on the one hand, of undoubted Ammonoidea that should be straight like an *Orthoceras*, and on the other hand of undoubted Nautiloidea that should possess a definite protoconch. When such a form was found, it would obviously be a matter of some difficulty to decide whether it belonged to the Ammonoid or Nautiloid branch; and if it really were the case that no criteria could be discovered, then such a form might claim to be a true connecting link. Still, there are certain minute features which are generally held, in a rough way, to distinguish these two orders; such are the position of the siphuncular passage through the septa, the nature of the external ornament, the contour of the septum, usually called the suture-line, and the proportions of length and breadth in the conch itself. These are characters well known to all who have ever worked on Cephalopoda, they are the ready means by which we tell an ammonite from a nautilus, and, as they are given with more or less accuracy in all text-books of palæontology, we need not further consider them. Enough to say that any straight, protoconch-bearing cephalopod shell can, by their means, be referred with a high degree of probability to its proper order.

The first step in advance was made by Branco, who showed that the straight *Bactrites*, from the Devonian rocks of Germany, possessed a well defined protoconch of ovoid shape (5). The affinities of *Bactrites* had before this been a subject of some dispute: while some placed it near the goniatites, others regarded it as merely a close ally of *Orthoceras*, differentiated therefrom only by the marginal position of the siphuncle. It was natural that the discovery of a protoconch

should, at least for a time, turn the scale in the direction of its ammonite affinities. To this argument Branco added the fact of its resemblance to the young of *Mimoceras compressum* and the presence of a dorsal lobe in the suture-line. This leads us straight to the recent observations of J. M. Clarke.

At various localities in Ontario and Livingstone counties, New York, at a horizon corresponding with that of the German *Bactrites*, Clarke has found numerous specimens, representing three or four species, of straight cephalopod shells, all possessing protoconchs. Some of these he refers to the genus *Bactrites* (7), while another he prefers to regard as *Orthoceras* (6).

Concerning *Bactrites*, Clarke is doubtful whether the specimens described by Branco were really of this genus; but he is convinced that his own material "corresponds, even to its specific characters, with that upon which the genus was established." Assuming the correctness of Branco's reference, the descriptions now given by Clarke supplement and in some respects set right those of Branco. The protoconch of the American specimens is not ovoid, but "bubble-shaped, frequently a little unsymmetrical or directed to one side, very broadly sessile upon the end of the shell tube, from which it is separated by a sharp constriction" (Fig. 1, *a*). The position of the siphuncular passage, even in the first septum, is distinctly lateral (Fig. 1, *b*). Where the siphuncle passes through the septa, it is surrounded by backwardly directed siphuncular collars or 'septal necks.' These septal necks are often so inclined as to be attached to the shell-wall, so that when the shell-wall is removed, the outer portion of the neck is almost invariably carried away with it. Thus an apparent dorsal lobe is formed (Fig. 1, *d*); and it is on this lobe, which does not really exist, that Branco has based some of his argument as to the affinities of his specimens.

The specimen referred by Clarke to *Orthoceras* is briefly described (Fig. 2, *a*, *b*). "It consists of the first or apical chamber of the shell, to which the protoconch is attached. The upper end of the specimen shows the first septum (not counting the 'apical plate' separating the protoconch from the first chamber) to be circular and with a central sipho. The lateral walls of the first chamber taper rapidly to the plane of conjunction with the protoconch and its depth is about one-half that of the latter. The protoconch itself is semi-ovoid in shape," and tapers slightly towards the apex as does that of *Belemnites*. It is of large size, as compared with the protoconchs of *Orthoceras* described by Hyatt, and "shows no indication of shrinkage or other irregularity, and its distal extremity is perfectly smooth." The specimen is referred to *Orthoceras* because the siphuncle (as shown in Fig. 2, *a*) passes through the centre of the first septum, and is not lateral as in the associated specimens of *Bactrites*. Larger specimens referred to *Orthoceras*, but without

the protoconch, do occur in these beds. The large size and unshrivelled condition of the protoconch is supposed by Clarke to be due to the fact that it may have been "derived from a shell so young that atrophy and wrinkling have not manifested themselves as they may have done with the more mature development of the shell."

The caution of this writer is so extreme that it is a little difficult to understand exactly what he does think, and it would be hazardous to give his conclusions in any words than his own. "If," he says, "the evidence presented brings us to the conclusion entertained by many of the older palæontologists, that *Bactrites* is closely related to *Orthoceras*, this conclusion is attained, by means of data not before elaborated, namely, the existence in both of like protoconchs. This fact, fortified by the decisive evidence that in *Bactrites* the sipho is strictly intra-marginal, the formation of a dorsal lobe wholly casual, leads to the conviction that *Bactrites* is little else than an orthoceran nautiloid with a lateral sipho. Both Branco and Hyatt have suggested the probability of *Belemnites* having been derived from orthoceran stock. Hyatt demonstrates that the guard or rostrum in this genus is a hypertrophic secondary deposition about the earlier parts of the true conch, similar to the plug which is sometimes found filling the distal fractured extremity of the sipho of orthoceratites. The similarity of structure in the true conch of *Belemnites*, *Bactrites*, and *Orthoceras*, is now increased by the demonstration of like protoconchs in all."

It is not clear whether Clarke would deny the goniatite affinities of *Bactrites*, or at least ally it more closely to the nautiloid *Orthoceras* than he would to any ammonoid; or whether he believes in the existence of a straight protoconch-bearing ancestor for each order, *Bactrites* being the ammonoid and *Orthoceras* the nautiloid ancestor, and the coleoid ancestor being as yet doubtful. The latter view, or something like it, seems to me to be nearer the truth; but I fear it is the former that is held by Clarke. It is therefore well to point out that his new observations do not necessarily support that view. If the protoconch which he figures in *Bactrites* does not so closely resemble that of *Mimoceras compressum* as the one figured by Branco, at all events the whole initial part of the shell, with its "*Oncoceras*- or *Gomphoceras*-like swelling of the shell-tube directly above the protoconch," bears a very striking resemblance to the young of *Agoniatites fecundus*.[2] Of course no stress can be laid upon the backward direction of the septal necks, for, as this is the direction in the ammonoid young, it is also the direction that we should expect to find in the ammonoid ancestor. The lateral, even if not marginal, position of the siphuncle is a bit of positive evidence strongly in favour of the ammonoid affinities of *Bactrites*. The sculpture also reminds one of the more primitive goniatites rather than of a nautiloid. The evidence of the so-

[2] Barrande. "Système Silurien," vol. ii., Suppl., pl. 490, fig. ii.,·1.

called *Orthoceras* (Fig. 2) is also not wholly convincing. In this case the central position of the siphuncle is not positive evidence, for, as shown by Branco, Hyatt, and others, the siphuncle of Ammonoidea changes its position during growth.[3] It is certainly open to us to suppose that an ancestral form may have had a central siphuncle, and on *à priori* grounds one would expect such to have been the case. Consequently this so-called *Orthoceras* may not be a true *Orthoceras*, and may not be a nautiloid at all. If this were the case there would be no grounds on which to base any argument. But, assuming for the moment that Clarke is right in calling it *Orthoceras*, then it tends to prove precisely what we anticipated, namely, that the ancestral nautiloid had a protoconch; but it certainly does not prove that *Bactrites* was a nautiloid, any more than it proves that *Mimoceras* was a nautiloid, which latter would be a *reductio ad absurdum*.

We pass now to Clarke's last paper, which he somewhat rashly entitles "Nanno, a New Cephalopodan Type" (8).

The specimens described were found in the Trenton series at various localities in Minnesota. Their combined evidence enables us to describe the complete shell as follows. The general outline of the shell may be gathered from Fig. 3, *c*; it appears to be assumed that this represents almost the entire length of the shell, but the evidence that such is the case is not satisfactorily brought out, and one would imagine that the outer shell-wall might have extended further forward than is shown in this drawing. The phragmacone, then, consists of a relatively wide tube, suddenly swelling and again diminishing towards the apex. The septa are concave and relatively close together. They are penetrated by a relatively wide siphuncular passage, which has an absolutely marginal position just as in the Mesozoic belemnites. "The septa," says Clarke, "are abruptly deflected immediately about the sipho." This may mean either that they are bent upwards on that side towards the shell-aperture, or that their margins are bent downwards around the siphuncle so as to enclose it in a tube formed of septal necks. Either of these explanations is consistent with the figures, and the latter agrees with what we know of most of these primitive cephalopods; it is, in fact, this 'neck-tube' that is usually, though wrongly, termed the siphuncle by palæontologists. Wrongly, because the siphuncle, as already pointed out, is a fleshy extension of the soft body, and an extension which, strictly speaking, contains none of the viscera. In the present instance the width of the passage is so great that we may well suppose it to have been occupied by a visceral cone, rather than by a simple siphuncle; and this supposition would explain the apparent shallowness of the body-chamber in this form as also in *Piloceras* (see Fig. 5, I). In figures 3, *b* and *c*, the siphuncular tube is seen to be constricted where it passes through the septa, and this

[3] This also took place in *Orthoceras* itself, as lately shown by Foerste, but that does not affect the argument.

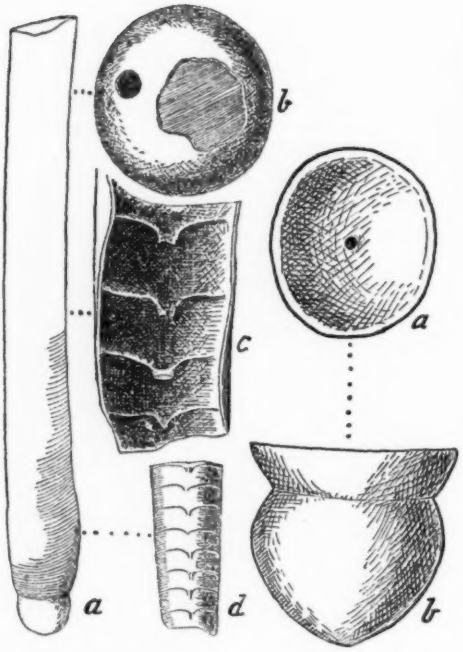


FIG. 1. FIG. 2. FIG. 3.

FIG. 1.—*Bactrites*. *a*. A shell retaining the protoconch and showing the expansion of the initial tube and the ornamentation (*B*. cf. *gracilis*). ×16. *b*. The distal surface of the first septum (somewhat broken), in *B*. *aciculum*, showing the lateral position of the siphuncular passage. The margin of the septum on the left is the line between light and shade. ×50. *c*. Interior of a portion of the shell of *B*. cf. *gracilis*, showing the intra-marginal position of the septal necks. ×4. *d*. Dorsal view of an internal calcareous cast of *B*. cf. *gracilis* showing the usual lobed appearance of the sutures. ×$\frac{3}{4}$.

FIG. 2.—*Orthoceras* (?), from Genesee shales. *a*. First septum, seen from above, showing central siphuncular passage. ×29. *b*. Protoconch and first loculus. ×35.

FIG. 3.—*Nanno aulema*. *a*. Vertical longitudinal section of the apical portion of the infilling of the siphuncular passage and protoconch; a. the internal cavity; b. calcite lining, with a streak indicating pause in deposition. *b*. A similar specimen seen from the exterior, showing swollen smooth apex and annulated siphuncular tube. *c*. The most complete example observed, showing siphuncular tube on left, constricted where it passed through the septa, lower down some septa, and then the conical apex. All ×1.3.

(All these figures are adapted from J. M. Clarke.)

also suggests that it was, during life, filled with some material that exerted pressure on its walls; the material would naturally be the generative glands.

The conical apex of the shell is not septate, but is entirely filled by the so-called sipho, which, before it passes through the first-formed septum, is greatly swollen so as to occupy all the space in the cone behind this septum, except a small wedge-shaped space next to the septum. This at least is what I gather from the following sentence, which I quote because I do not quite understand it. "The first septum seems not to conform to the contracted surface of the cone, which has a much greater obliquity, and there thus appears to be an irregular wedge-shaped cavity between these two surfaces, but there is no evidence whatsoever that the conical end of the sipho was in any way involved in this cavity except at its upper surface." This conical end of the siphuncular tube was covered by a very thin coating of shell, "a mere film." It has, however, been preserved to us, and preserved more constantly than any other part of the shell, owing to the fact that it became lined during the life of the animal by a secondary deposit of carbonate of line (Fig. 3, *a*). This deposit is very similar in structure and appearance to the well-known guard or rostrum of the belemnite; but, since it is inside and not outside the phragmacone, it cannot possibly be homologous therewith. It may better be compared to the plug of secondary calcite that repaired the ends of many individuals of *Orthoceras*, which were broken during life, or to the deposit that lines the siphuncular passage of *Actinoceras* (Fig. 6). Considerable stress is laid by Clarke on the fact that a break occurred during the deposition of this secondary calcite, so that it is divided into at least two portions "the line between which is represented only by a faint streak or difference in the texture." And this he regards as "indisputable evidence that the sipho enclosed or was composed of siphonal sheaths, as in *Piloceras*, *Vaginoceras*, and *Endoceras*." (See Fig. 5, I). This, nevertheless, I for one propose to dispute a little later on.

Before proceeding, however, with further criticism, it seems advisable to point out the very close resemblance that exists between these specimens now described by Clarke and specimens described nine years ago by Holm (10), which were found in beds of almost identical age in Oeland, Esthonia, and Prussia. A rough sketch (Fig. 4) made from some of Holm's figures by my friend A. H. Foord (9) is here reproduced, as it shows better than anything else could do the extraordinary likeness that obtains between the *Endoceras belemnitiforme* of Holm and the *Nanno aulema* of Clarke. In both we see the relatively close septa, penetrated by a wide siphuncular passage on the extreme margin (Fig. 4, *c*); the constriction of this passage by the septa, which bend downwards as septal necks and curve upwards towards the shell aperture on the side of the siphuncle; the swelling of the passage so as to fill almost, but not quite all the apex of the

cone; the thin shell-wall, and the lining of the apex by secondary calcite. The only differences to be detected from the figures are the cigar-like swelling of the slightly smaller phragmacone in *Nanno*, and the straighter external edge of the siphuncular passage in *Endoceras belemnitiforme*. These, however, are features of specific value at the very most, and it certainly seems that Clarke describes his specimens as representing "a new cephalopodan type," only because, in a state of oblivion most unusual with him, he has overlooked not merely Holm's elaborate paper but also Foord's well-known Catalogue of Fossil Cephalopoda in the British Museum. Whether Holm, who discussed the affinities of his species, will now be inclined to accept its generic independence must be left for him to say. But before these new

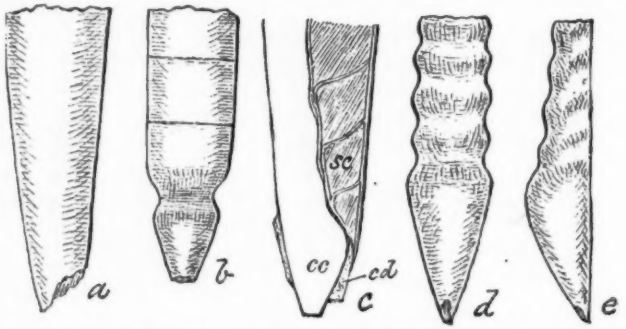


FIG. 4.—*Endoceras belemnitiforme*, Holm. *a*. Apical portion of phragmacone, covered with test. *b*. Internal cast of the same, denuded of the test, showing two septa. *c*. Sagittal section of the same, showing conical chamber (*cc*) at the apex of the siphuncular passage, some of the loculi (*sc*) separated from the siphuncular passage by the septal necks, and the secondary calcareous deposit (*cd*) lining the apex. *d*. Internal cast of the siphuncular passage and protoconch. *e*. Side view of same; compare Fig. 3 *b*. All × .6.
(Drawing by A. H. Foord, after G. Holm; the block kindly lent by Dr. H. Woodward, F.R.S.)

names find general acceptance, one would be glad of some hint as to their meaning. *Aulema*, every schoolboy will tell you, means a piece of music for the flute; but *Nanno*—what is *Nanno*? As a Japanese would say, "*nanno*?, of what?"[4]

To return to the meaning and structure of these undoubtedly interesting forms. There is, I submit, no evidence that *Nanno*

[4] Since this was in type, Dr. Clarke, whom I had informed of my sanguinary intentions towards his offspring, has kindly written me on the subject. He says, "I do not at all agree with Holm in placing the shell within the limits of *Endoceras* . . . the true *Endoceras* is septate to the narrowest apical extremity which has been observed." Also, "*Nanno* is a reactionary euphemism. I had thought at first to call it *Featherstonhaughoceras*, after an early explorer of Minnesota, but my mind gave way, and so I wrote it *Nanno*, though she is only a dead nymph who was fond of a flute." Dr. Clarke has clearly a larger circle of female acquaintance than was possessed by the compilers of my various classical dictionaries; and for this the gods should undoubtedly still be praised.

possessed 'sheaths' like those of *Piloceras* and some species of *Endoceras*. The faint streak described by Clarke is nothing more than one may see any day in a common belemnite guard, and merely indicates a slight pause in the deposition of the calcite, of no morphological significance whatever. The sheaths of *Piloceras*, well shown in Fig. 5, I, are clearly defined structures of a totally different origin. It may be worth while considering what that origin is. It seems pretty clear that in most of these archaic Cephalopoda the visceral cone extended to the depth of at least two loculi down the siphuncular passage. Since, like the visceral hump, it had the power of secreting shell, it formed, when in this position, long septal necks which often fused to form the neck-tube. We know that in *Nautilus* and *Spirula*, after the secretion of the septal necks, the outer coat of the siphuncle, both inside and outside the region of the septal neck, becomes hardened by calcium carbonate; this gives it a certain rigidity, and assists its retention in the fossil state. The same thing must have occurred in the coat of the visceral cone. Now, in *Piloceras*, when the animal advanced in the shell its viscera naturally followed it, and by suction the walls of the visceral cone were drawn in so as to form the narrow and empty siphuncle. At least such would have been the case had not the stiffness of the outer coat prevented complete yielding of the skin, especially at the posterior part where the siphuncle tended to begin, but where the coat was most calcified. It must therefore have happened that the inner layers of the skin were gradually torn away from the outer layers. Another stiffening of the skin would take place higher up, and the process would be repeated. Thus the 'sheaths' of *Piloceras* are nothing more than the remains of these old coats, left hanging on the siphuncle all the way up the passage (Fig. 5, I, *r* and *s*). The siphuncle is of course the structure that is often perplexingly called the "endosiphon." In some species of *Endoceras* the secondary calcification of the skin of the visceral cone seems to have advanced further, and the siphuncular cavity is divided into chambers

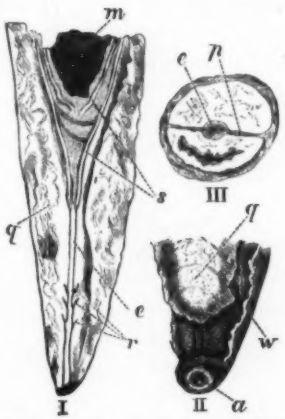


FIG. 5.—*Piloceras*. I. Longitudinal section of the siphuncular passage; *q*, quartz filling the greater part of the neck-tube cavity; *m*, matrix occupying the former position of the visceral hump; *s*, 'sheaths,' or calcified coats of the visceral hump; *e*, the siphuncle or so-called 'endosiphon'; *r*, remains of former sheaths (?). II. Posterior extremity of a similar specimen, much eroded, but showing an aperture, *a*, at the apex; *w*, the neck-tube; *q*, quartz infilling between neck-tube and one of the sheaths. III. Transverse section of a similar specimen, showing the outer wall or neck-tube and the siphuncle *e*; *p* is a partition the appearance of which is exaggerated and the significance of which is unknown.

(All figures of natural size; drawn by A. H. Foord; the block kindly lent by Dr. H. Woodward, F.R.S.)

by a series of hollow cones at irregular intervals. It is possible that the actual moment of casting off the slough was after the emission of the generative products, when the visceral cone was flaccid; this explanation coincides with Seeley's explanation of the origin of septation itself, but it is not exposed to the objections brought against the latter (14). There is, of course, no reason why "sheaths" should not have been formed in *Nanno*; but, to judge from the descriptions and figures of Holm and Clarke, no trace of them has yet been seen.

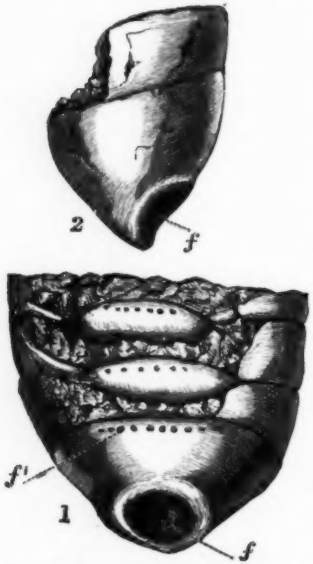


FIG. 6.—*Actinoceras*. 1. Front view of a weathered apical extremity, from which the shell has been removed. 2. Side view of another specimen. *f*, a large aperture at the apex; *f'*, the openings of small passages leading through the calcite infilling the neck-tube to the siphuncle, and probably representing the last relics of the attachment of the siphuncle to the wall of the neck-tube.

(Both figures natural size; drawn by A. H. Foord; the block kindly lent by Dr. H. Woodward, F.R.S.)

The feature of chief interest in *Nanno* is the apical swelling of the siphuncular passage. This was considered by Holm to represent the initial chamber, "Anfangskammer," by which he presumably meant the protoconch. Such, indeed, in spite of its large size, it appears to have been, and as Clarke observes, it probably contained the body of the young animal for a considerable period. That the forward movement of the young was quite gradual, is possibly indicated by the solidity of the calcareous deposit lining the walls of this apical chamber. If this suggestion be correct, it becomes interesting to compare this protoconch with the structures noticed above in the so-called *Orthoceras* from St. Cassian (see p. 425). The depression seen so clearly in Fig. 4, *b*, may well represent the constriction and the "shoulder" of the cicatrix alluded to by Hyatt in those specimens; while the plug of calcite in the *Orthoceras* is the diminished representative of the calcareous lining in *Nanno*. There is perhaps no importance to be attached to the fact that a swelling of the shell at a little distance from the apex occurs in *Nanno aulema*, *Orthoceras politum*, *Bactrites*, and *Agoniatites fecundus*; but it is certainly more worthy of remark than any resemblance to *Gomphoceras* and *Oncoceras*, such as Clarke insists upon.

Assuming that the somewhat similar structures seen in these forms are protoconchs in the strict sense, then it is clear that there is a great difference between them and such other primitive forms as

Piloceras and *Actinoceras*. As Clarke justly says of *Piloceras*, "were it possessed of such a solid apical sipho as is *Nanno*, that would be the part most readily preserved, as in this case." We have, however, more definite reason for believing that no such solid protoconch was present in *Piloceras* and *Actinoceras*. Figure 5, II., and figure 6 show at the end of the conch a wide aperture with a raised rounded edge. It is the opinion of Foord, with whom I heartily concur, that the siphuncle passed through this opening into the protoconch (9, pp. 159 and 166). The non-retention of the protoconch in a fossil state therefore seems due to the fact that it was composed of thin conchiolin, just as we have already inferred the protoconch of the ancestral Nautiloidea to have been; while the raised rim is remarkably like the rim of the cicatrix in a recent *Nautilus*. In these cases, not only was the protoconch more fragile, but the secondary infilling of the siphuncle tube did not extend into the protoconch as it did in *Nanno* and as it is here considered to have done in *Orthoceras elegans* and *O. politum*.

It appears a legitimate conclusion from the facts here quoted, that, however far back we trace the Cephalopoda, we still find two divisions: the one characterised by a relatively solid protoconch, often of relatively large size, and often preserved in a fossil state; and the other either possessing no protoconch, or one that was formed of material too delicate to be preserved, but characterised instead by an aperture with raised rim or by its degenerate representative, the cicatrix. To the former division are to be referred all the undoubted Ammonoidea and Coleoidea, while to the latter division are to be referred all undoubted Nautiloidea. We are therefore not entitled to say that the Ammonoidea were derived from the Nautiloidea, although we may not doubt that all three orders sprung from a common ancestral stock first evolved in far pre-Cambrian times. Of course it follows from this that the St. Cassian species referred to *Orthoceras* by Klipstein, as well as the specimen shown in Fig. 2, which Clarke refers to the same genus, cannot belong to the Nautiloidea at all, but are ancestral forms of the Ammonoidea and possibly of the Coleoidea. It is indeed probable that many other species hitherto referred to the loosely defined genus *Orthoceras*, or to some other genus of presumed Nautiloid affinities, will eventually have to find another resting-place. This is a question for those with more special knowledge than I possess.

Although in this article some adverse criticism has been bestowed on my Transatlantic friends, yet the facts that they have brought to our notice have a very real value. They have shown that the principles that have hitherto guided us have not been erroneous, and they have extended the basis of our argument by the width of a Hemisphere. I feel therefore some confidence in once more making a suggestion (3) originally placed before the Geologists' Association in March, 1888, but which, since it was not considered worthy of publi-

cation, did not find its way into print until quoted in the *Proceedings* of that Association in April, 1892 (4). The suggestion, put briefly, was that, at an early period, the Cephalopoda split into two great divisions: one division—which, starting with a very fragile protoconch, soon lost it altogether—may be called the *Lipo-protoconchia*, and is practically co-extensive with the Nautiloidea; the other division—which, starting with a stouter protoconch, preserved it, either by the coiling of the conch around it as in the Ammonoidea, or by its ensheathement in the mantle as in the Coleoidea—may be called the *Sosi-protoconchia*. And it was further suggested that such a classification, based upon ascertained facts of shell-structure, might prove superior to other classifications based upon suppositions as to the soft parts which could never be confirmed.

REFERENCES.

1. **Bather, F. A.**—"Shell-growth in Cephalopoda (Siphonopoda)." *Ann. Mag. Nat. Hist.* (6), vol. i., pp. 298–310; 1888.
2. ——————— "Professor Blake and Shell-growth in Cephalopoda." *tom. cit.*, pp. 421–427; 1888.
3. ——————— "Classification of the Cephalopoda." *Amer. Geol.*, vol. x. pp. 396, 397; 1892.
4. **Blake, J. F.**—"The Evolution and Classification of the Cephalopoda, &c." *Proc. Geol. Soc.*, vol. xii., pp. 275–295, with folding tables; 1892.
5. **Branco, W.**—"Ueber die Anfangskammer von *Bactrites*." *Zeitschr. deutsch. geol. Ges.*, vol. xxxvii., pp. 1–9; 1885.
6. **Clarke, J. M.**—"The Protoconch of *Orthoceras*." *Amer. Geol.*, vol. xii., pp. 112–115; 1893.
7. ——————— "The Early Stages of *Bactrites*." *Amer. Geol.*, vol. xiv., pp. 37–43; 1894.
8. ——————— "*Nanno*, a new Cephalopodan Type." *tom. cit.*, pp. 205–208; 1894.
9. **Foord, A. H.**—"Catalogue of the Fossil Cephalopoda in the British Museum, &c. Part I." London, 8vo; 1888.
10. **Holm, G.**—"Uebere die innere Organisation einiger silurischer Cephalopoden." *Palæont. Abhandl.*, vol. iii., Heft 1; 1885.
11. **Hyatt, A.**—"The Evolution of the Cephalopoda." *Science*, vol. iii., pp. 122–127 and 145–149; 1884.
12. ——————— "Genesis of the Arietidæ." *Smithsonian Contrib.*, no. 673; 1889.
13. **Schwarz, E. H. L.**—"The Descent of the Octopoda, &c." *Journ. Marine Zool.*, vol. i., pp. 87–92; 1894.
14. **Seeley, H. G.**—"On the Septa and Siphuncles of Cephalopod Shells." *Quart. Journ. Sci.*, vol. i., pp. 760–762; 1864.
15. **Steinmann, G.**—"Vorläufige Mittheilung über die Organisation der Ammoniten." *Ber. naturf. Ges. Freiburg i. B.*, vol. iv., Heft 3, pp. 31–47; 1888. See also "Elemente der Paläontologie," 2 Hälfte, 8vo, Leipzig; 1890.
16. **Waagen, W.**—"Palæontologia Indica, ser. xiii., Salt-Range Fossils, 1b, Cephalopoda"; 1879–1880.

F. A. Bather.

III.

The Wing of Archæopteryx.

Part II.

I PROPOSE now to comment briefly upon a few of what seem to me to be the most important restorations hitherto made.

That of Professor (afterward Sir Richard) Owen first claims attention. This was the result of a careful study of the then recently-discovered fossil now in the British Museum. Bearing in mind the very fragmentary condition of the manus, this restoration must be admitted to be an exceedingly shrewd one. (See Figg. 1 and 2.)

We are told (14) that the "hand of Archæopteryx, besides being concerned in supporting the remiges or quill feathers of a wing, also supported two moderately long and slender free digits, each terminated by a strong, curved, and sharp-pointed claw. . . . The parts of the present skeleton show a certain amount of dislocation, and one of the claw-bearing digits may have belonged to the left [*i.e.*, right] wing." In the accompanying restoration, digit I. will accordingly be found to be marked with a ?, a doubt probably engendered by the obvious difficulty of accommodating the necessary carpal and metacarpal bones. We may, I think, safely predict that if Owen had had an opportunity of examining both the London and Berlin fossils at the same time, he would have given the London specimen a tridactyle manus, making his digit I. do duty for the penultimate and ungual phalanx of his digit III.; thus the wings of the two fossils would have been found to be precisely similar.

Of the Berlin example I wish to draw attention to at least six restorations. The first of these is that of Professor Vogt (20). In describing the manus he says: "The carpus shows only a single spherical bone." "On each manus (there are) three long slender digits, armed with claws" ". . . the radial digit or pollex (1) is the shortest, the other two are nearly of equal length, but the second is longest. These two digits were evidently united by tendinous and close aponeuroses; for in each manus these digits are placed in the same way, the one over-riding the other. The pollex is composed of a short metacarpal, a pretty long phalanx, and a terminal claw-bearing phalanx; the other two digits have, besides the metacarpal, three normal phalanges. The remiges were fixed to the ulnar side of the

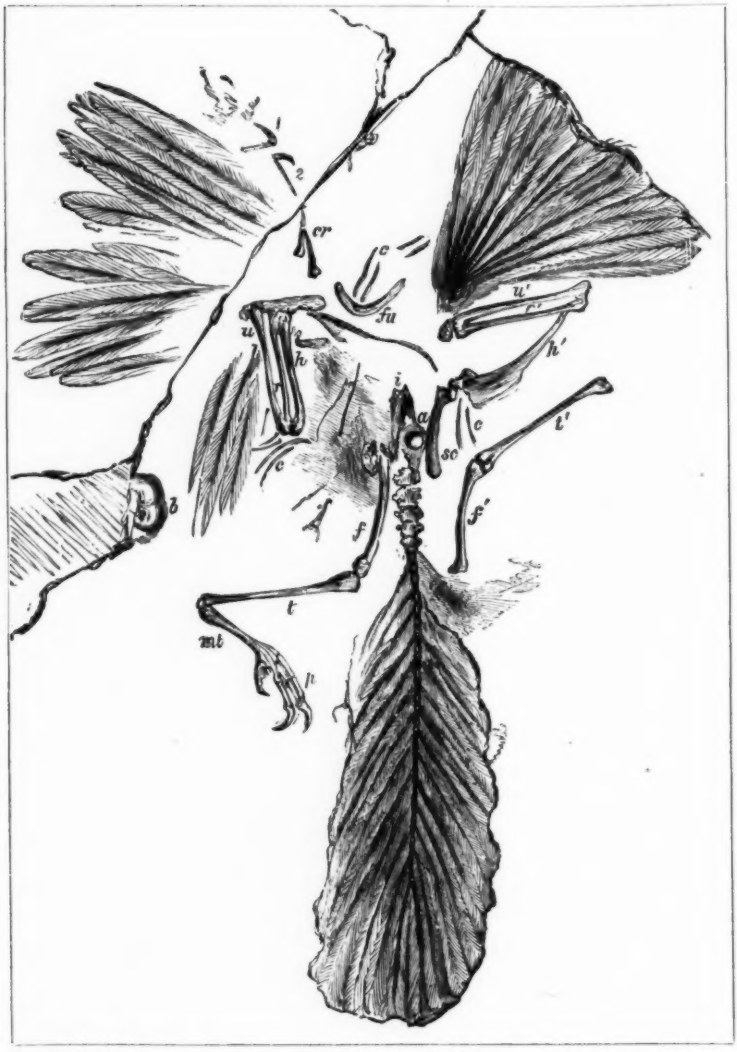


FIG. 1.—The specimen of *Archæopteryx* in the British Museum. About $\frac{1}{4}$ natural size. Explanation of letters:—*1*, *2*, portions of wing-digits, with claws; *cr*, metacarpals; *u*, *u'*, ulna; *r*, *r'*, radius; *h*, *h'*, humerus; *sc*, scapula; *fu*, furculum; *c*, ribs partly sternal); *l*, feathers; *i*, innominate bone; *a*, acetabulum of the same; *f*, *f'*, femur; *t*, *t'*, tibia; *mt*, metatarsus; *p*, phalanges; *b*, supposed cast of brain.

The block kindly lent by Dr. H. Woodward, F.R.S.

forearm and manus, though no special adaptation to this end can be observed in the skeleton. The pollex . . . bore no bastard-wing. . . . The wing is rounded in outline, like that of a fowl." This description is supplemented by the accompanying figure, which, though somewhat diagrammatic, is correct in its proportions. (Fig. 3.)

Professor Dames in his exhaustive monograph (1) discusses the manus at considerable length. The carpus in particular receives a large share of attention. With Vogt, Dames agrees that only one free carpal bone is visible on the slab, and this, he says, from its position, must represent the radiale, and, judging from its size, probably afforded an articular face for the metacarpals I., II., and perhaps even III., though he suggests that it is probable that metacarpal III. may have articulated with a separate carpal—the ulnare, which is yet concealed under the stone. Attention is drawn to the large size of the radiale, Dames remarking that, while in adult living birds the radiale may vary in size relatively to the ulnare, in the embryo the radiale is the smaller bone, so that, coupled with the fact that there are no free distal carpals, the carpus of Archæopteryx agrees rather with the adult than with the embryo of living birds. The existence of two proximal carpals is considered almost certain, since he reminds his readers that, among modern birds, the only instances in which the carpus has been reduced to a single distinct bone[1] in the adult are instances in which the power of flight has been lost, *e.g.*, *Casuarius* and *Apteryx*.

FIG. 2.

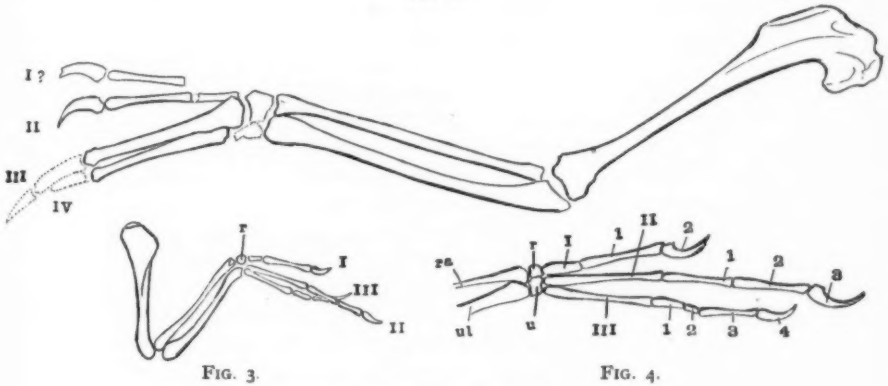


FIG. 3. FIG. 4.

RESTORATIONS OF THE WING OF ARCHÆOPTERYX.

FIG. 2. From the London specimen, after Owen.
FIG. 3. From the Berlin specimen, after Vogt.
FIG. 4. From the Berlin specimen, after Dames.

Further on Dames again refers to the carpus. Here attention is drawn to a groove running across the surface of the large free carpal

[1] The carpal in these cases is the ulnare.

(radiale) just described, which he suggests may—if it have any meaning at all—represent the boundary line between the radiale and ulnare, so that after all we may be dealing, not with one, but two bones, the homologues of the existing proximal carpals. As to the probability of a distal row of carpal bones, Dames writes: "There can be no doubt, speaking generally, that a distal row of carpals was laid down (angelegt), since they are laid down in every reptile, in every bird, indeed in every vertebrate, with the possible exception of the fish; and if this be admitted, the appearance of our specimen shows that they must have fused with the metacarpals." The nature of this view is next discussed. Quoting Rosenberg, he tells us that in the embryo of living birds the carpals 1–2 appear from the very first, not as separate elements, but as a single piece. Carpals 3–4 are similarly developed. The metacarpals[2] first approximate with their corresponding carpalia or their equivalents, and then fuse with them and with one another; but in Archæopteryx, we are reminded, these metacarpals are free: it is therefore open to question whether (i) the development of these carpals in Archæopteryx proceeded after this manner (*i.e.*, as carpals 1–2 and 3–4); or (ii) as carpals 1 and 2, 3 and 4; or (iii) whether the cartilaginous body, which Rosenberg supposed to represent 1 and 2, really only corresponds to 2, in which case the first metacarpal would articulate, not with a carpal of the distal, but of the proximal row—the radiale.

Now if my reader will turn to p. 353, Fig. I., he will see at a glance that Dames' interpretation of this region differs fundamentally from my own, inasmuch as what that writer believes to be the radiale I imagine to represent a fused row of distal carpalia, while the proximal carpals seem to me to be distinctly indicated, in the photographs, in the space between this distal row and the end of the forearm. On referring to the text, it will be seen that I have even gone so far as to suggest the presence of an intermedium. Now, supposing I am right, mark how much this matter will be simplified. Turning again to p. 353, it will be seen that in Fig. II.—the wing of the ostrich—we have precisely the arrangement of carpal bones that I believe to have existed in Archæopteryx, viz., two free proximal carpals—perhaps three—and a fused row of distal carpals. The difference between the two wings lies in the fact that in Archæopteryx the metacarpals were probably distinct from one another and from the distal carpal mass throughout life, whereas in the ostrich they become anchylosed when the adult stage is attained. Thus the carpus of Archæopteryx represents neither the early embryonic nor the adult stages of modern birds, but rather the late embryonic and post-embryonic stages. Although my view of the matter bears the stamp of probability, it cannot, of course, be accepted in any other light than that of a suggestion, and in this spirit

[2] Metacarpal IV. enjoys but a transitory existence.

I have submitted it to my critics, trusting that it may lead to a careful re-examination of the Berlin fossil, which, as I have previously stated, I have never seen.

Judging from Professor Seeley's description of this fossil (19), there seems a possibility that my rendering of the carpus may prove to be correct. He pointed out that it was a moot point whether the large free carpal described by Vogt belonged to the proximal or distal row, and in the same paper he says: "The middle metacarpal . . . so far as I can see, terminates proximally in a rounded carpal bone like that of a bird"; thus I imagine he believed, as I do, that the bone in question represented the distal carpals, and not the radiale, as Dames seems to think.

There seems to be some difference of opinion as to the number of phalanges in digit III., some describing three, others four. Judging from the evidence of the wing alone, one would be inclined to think that there were not more than three, and that the appearance of four phalanges was due to the fact that the first phalanx of digit III. had been snapped in two across its distal third, the dismembered portion afterwards slightly drifting apart. Since, however, we get precisely the same effect in both wings, this can hardly be deemed the result of an accidental fracture; though it is, perhaps, equally hard to account for the fact that they happen to have separated in an exactly similar way in each wing. Though this arrangement of a short phalanx intercalated with two long ones is not unique, it certainly in this case appears in its most exaggerated form.

Professor Dames has supplemented his description by an outline restoration, Fig. 4; this, however, is probably not intended to do more than represent in a very diagrammatic way the salient features of the wing. It is strange, however, that he should have based this restoration upon Gegenbaur's figures of the developing wing of an embryo chick, since, as Dames himself shows, this eminent anatomist was deceived as to the real nature of the avian embryo carpus. In Gegenbaur's figure referred to, there is but one row of free carpals, which represent the radiale and ulnare. The ulnare is of great size and not only supports digits II., III., but contributes to that of digit I. There is no indication of a distal row, for Gegenbaur believed that at the time of the differentiation of the cartilaginous skeleton, only the radiale and ulnare were present, and that, even in their beginnings they showed no trace of fusion with other carpal elements. In Dames' figure accordingly, the ulnare entirely supports digits II. and III., while the radiale bears digit I. Thus the ulnare is much larger than the radiale, whereas Dames laid great stress on the large size of the latter of these two bones in the fossil; so large, indeed, did it appear to him there, that he imagined it must certainly have afforded an articular surface for digits I., II., and perhaps even III. It is probable that, in studying Gegenbaur's paper, the groove across the "large free carpal," which he at first dismissed from con-

sideration as probably having no real significance, came back upon him with new force, this time bringing conviction with it.

The remiges or quill feathers are briefly referred to. Of the primaries (metacarpo-digitals), Professor Dames tells us that they were attached, not only to the metacarpus, but extended down to the claw of the longest finger—digit II. The shafts of these primaries, he considers, having regard to their function as "Schwungfeder" (quill feathers), to be somewhat thin and slender. Here, again, it will be seen that my restoration does not quite agree with Dames' description. Turning to Pl. II., Fig. I., it will be noticed that the quills are supposed not to have extended beyond digit III., and I think there is every reason to believe that this was actually the case. The shafts of these quills are certainly slender, but not relatively more so than is the case with very many birds of active flight to-day. In the large plate accompanying Dames' paper, all the remiges are represented as having a proximal overlap, an arrangement exactly the reverse of that which I have supposed to obtain when discussing this matter in Part I.

Our fourth restoration is that given by the late Professor Romanes[3] (17), Fig. 5. It is difficult to know what to say of this, for it agrees with neither the London nor the Berlin fossil, and looks rather like the outcome of a process of mental evolution than the result of a careful study of the actual specimens. In the figure it will be seen that though the relative length of the digits roughly corresponds to that of the Berlin fossil, the hand, as a whole, is too short. All three fingers are represented as perfectly distinct, freely moveable independently of one another, and apparently were not supposed to bear any part in the support of the remiges. It is just possible, however, that the third digit may have been credited with supporting, say, two or three primaries. Not even with a great stretch of imagination can the outline of the wing be likened to that of the Berlin fossil. I have taken it for granted that this restoration is intended to represent the Berlin example, and is not a combination of this and the London fossil, since in Owen's restoration, there were four digits, of which I. and II. were separate and apparently freely moveable, while III. and IV. (resembling digits II. and III. of modern birds) were supposed to have supported the primaries. Had Owen's restoration been present before the mind of the restorer, it is possible that these digits III. and IV., with their primaries, would have been made to supplement what were evidently meant for the three digits of the Berlin specimen. The animal is thus described (p. 172): "The extinct Archæopteryx . . . presents throughout its whole organisation a most interesting assemblage of 'generalised characters.' . . . For example, . . . its still

[3] This, it will be remarked, is stated to be "after Flower." Sir W. Flower tells me, however, that he cannot recollect either having published such a figure or having used it in lectures.

unreduced digits of the wings which (like those of the feet) are covered with scales." There is no *evidence* of the presence of scales on the feet, though they probably were thus clothed, but there seems

FIG. 5.—Restoration of *Archæopteryx*, $\frac{1}{3}$ nat. size, from "Darwin and After Darwin." The block has been kindly lent by Mrs. Romanes.

to me to be neither evidence nor *reason* to assume their presence on the fingers.

Dr. Hurst's restoration (6) took the world by surprise, but it remains to be seen whether it will stand the test of criticism. In order

that we may see the matter from Dr. Hurst's point of view, and thus enable ourselves to understand maybe the conclusion which he has arrived at, let us examine a few passages culled at random from his paper.

"The photograph accompanying this essay [reprinted on p. 351] shows the primary quills to have been supported by none of the first three digits, and justifies, if it does not even prove, the view that those quills were supported by the digits IV and V (or one of them). Portions of these large digits were figured by Owen thirty years ago, and they are seen in the London specimen and are quite unlike anything seen on the surface of the Berlin specimen, in which these digits probably still lie hidden."

Again: "If the dissected wing of a common bird . . . be compared with the plate of *Archæopteryx*, the conclusion that those two wings are essentially alike will be inevitable. It will be impossible to avoid the conclusion that the two digits which support the quills of the ordinary bird existed also in *Archæopteryx*, and their position will be seen to be indicated faintly in the photograph by a shadow which runs parallel with and behind the slender digits. The carpal angle of the wing will be seen in front of the carpal ends of the slender fingers, and from this point the outline of the anterior margin of the wing can be traced to the tip. This margin lies under those fingers. Not only did these, as their form and structure show, *not* support the quills, but they did not even contribute to the support of them. These fingers lie not in the wing at all, but *upon its feather-clad surface*. Those slender fingers, like the free fingers of the *Pterodactyla*, or of the recent 'flying' phalangers and squirrels, or of *Galeopithecus*, or like the pollex of a bat, are admirably adapted for climbing in trees. They proclaim *Archæopteryx* to have been a winged quadruped, . . ."

"Dames . . . states that the primary quills . . . were attached to the longest finger (II). If . . . we consider what would be the result of such an attachment, it must be obvious that it would be twofold. Firstly, the attachment of such a series of quills would render the fingers perfectly useless for climbing, and secondly, a single flap of that wing would twist the phalanges off at the joints."

Now as touching Owen's restoration. I have already pointed it out as more than likely that the phalanges Owen marked as digit I.? were really none other than the ungual and penultimate phalanges of digit II. Supposing this to be the case, it will be seen that the wing of both London and Berlin specimens are precisely similar.

We may therefore assume that the remiges in both fossils would have been attached in the same manner. If it can be proved then, so far as proof is possible, that these digits *could* have supported the remiges, we shall have gone a great way towards demolishing, or at any rate rendering pointless, Hurst's elaborate hypothesis. I feel convinced

that I have already shown this to be more than probable, and it remains for my readers to decide whether I am right, or whether, with Dr. Hurst, we are to regard these digits as too "*weak-jointed*" to bear the "torsional stress" to which they would be subjected.

As to the slenderness of the digits, I have already pointed out that relatively to the size of the wing they are not more slender than is the case in living birds; further, in so far as the metacarpals are concerned, that of digit III. is stouter than obtains to-day. The wing of the young ostrich presents an interesting exception (see p. 353, Fig. II). Here metacarpal III. is a relatively stout bone, as in Archæopteryx, but differs therefrom in being more bowed. Indeed this wing seems to represent a stage in the evolution of the avian manus between those of Archæopteryx and modern Carinatæ, since it possesses a fused mass of distal metacarpals, approximated to, but not fused with the three free metacarpals, and since all its digits end in a claw. Another stage is afforded by those birds that have the third metacarpal reduced to a slender bar, and only digits I. and II. ending in a claw; while in the highest birds even the claws are lost. As both Professor Fürbringer and Dr. Gadow have already shown, it is very evident that the ancestral ostrich must have possessed the power of active flight, and this power must therefore have been acquired while the metacarpals were yet free, as in Archæopteryx. Thus, then, we have a chain of connecting links between the wing of this ancient fossil and those of the highest living birds.

The weak-jointedness of the phalanges hardly need detain us long, inasmuch as, so far as I can see, the phalanges of living birds seem to be scarcely if at all more firmly bound together than were those of Archæopteryx; indeed, remembering the strong tendinous fibres and bands which bind together both skeleton and the supported remiges, any special mechanism or anchylosis of the joints would seem to be unnecessary. The presence of the digits which supported the primaries, Dr. Hurst tells us, is indicated on the slab by a "shadow which runs parallel with and behind the slender digits." Among some notes on the subject taken in Berlin, which Dr. Hurst has generously furnished me with, I find the following reference to these digits and the shadow:—"Supposed position of IV. and V. wrong! Supposed shadow is a yellow stain—? iron, and the supposed IV. and V. if present are completely hidden." This last qualification, "if present," looks very like a doubt and but for the fact that in a letter lately to hand he says "I do not in the least think that what you brought forward at Oxford weakens my case," I should have believed that he had surrendered his position, and therefore have considerably curtailed my review of his paper.

Yet a few more words remain to be said as to these additional fingers. Supposing them to exist, where did they articulate? The whole of the carpal space is evidently monopolised by the "three free digits," so that there seems no room for two, or even one more

finger, especially since that digit (or digits) must have been larger and stronger than any of the three now exposed.

A very serious objection, to my mind, against the probability of Dr. Hurst's theory is the obvious fact that the manus of Archæopteryx must have been highly specialised in two directions to fit it for two distinct modes of locomotion—flight and climbing—modifications, too, which must have gone on hand in hand, a possibility which I can

FIG. 6.—Reconstruction of *Archæopteryx*, from Koken, "Die Vorwelt"; by kind permission of the publishers.

hardly imagine. That the free fingers *have* become specialised, either for the purposes of climbing or those of flight, there can be no doubt, since no one would regard these digits as representing even a part of the unspecialised primitive manus adapted for ordinary walking or climbing purposes. In conclusion, I perfectly agree with Dr. Hurst when he says: "If Natural Selection has been operating long enough

and efficiently enough to determine the evolution of so perfect a series of feathers, it is perfectly certain that the same selection will have led also to the evolution of supports for those feathers as fully fitted to support the feathers as the feathers are fitted for flight; and even if there had been no indication of those supports on the slab, we need have still had no doubt as to their existence."

Professor A. Andreæ has recently distributed among his friends an outline restoration of Archæopteryx, which I have had an opportunity of seeing. Since it is not published technically, I am debarred from meting out to it the criticism that seems appropriate. Let it suffice to draw attention to the fact that the metacarpals are too short relatively to the length of the forearm, and that digit II. is too short relatively to the length of the metacarpals, while digit III. is too long by the same standard of measurement. This comparison, of course, is made with the Berlin fossil, from which these digits have been restored. The additional digits demanded by Hurst for supporting the quills have also been added, for the sketch was, as I am told, intended as a graphic interpretation of Hurst's paper.

Yet another restoration is that of Koken (10). This is a very interesting one, and is evidently founded upon Dames' hypothesis that the quill feathers "arose, not only from the metacarpus, but also from the phalanges of the middle of the three fingers, *i.e.*, II. It can be seen especially clearly on the left wing, if the quill of the first feather be prolonged towards the hand, that it must have rested upon the penultimate phalanx of the middle finger, close behind the claw." I think, however, that if Professor Dames will examine this fossil again, he will find that he ought to substitute the third for the middle finger as the recipient of the first primary.

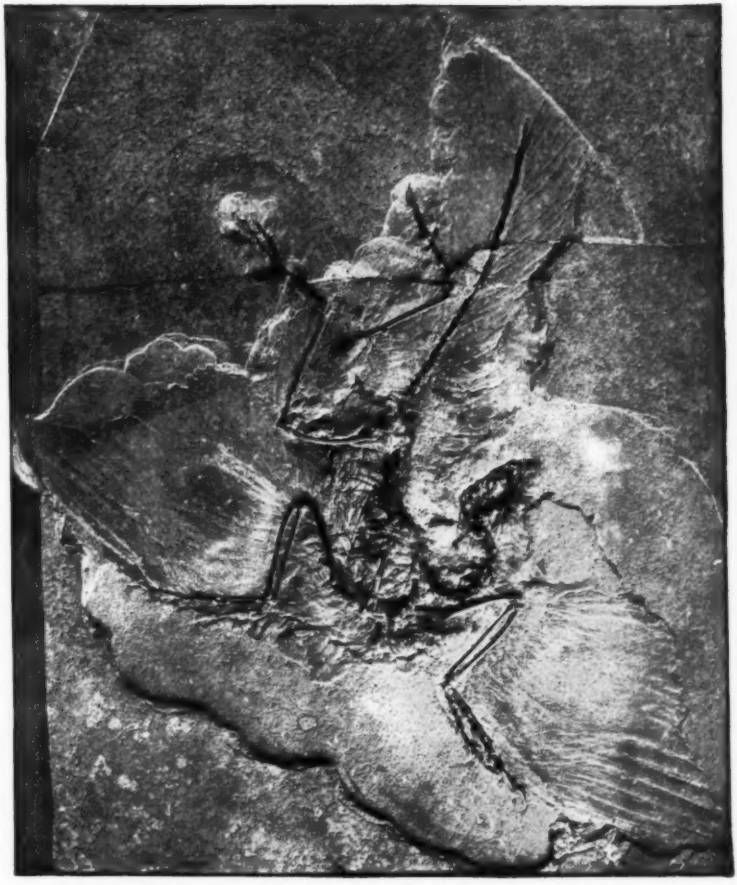
According to Koken the wing of Archæopteryx was still relatively small, and as Figure 6 shows, he believes the III. digit not to have been concerned in the support of the remiges, but to have been entirely free and functional. These remiges, it will be seen, have evidently been drawn without reference to their precise form and length as seen on the slab.

But for fear of becoming wearisome to my readers, I would fain pass on to review briefly a few of the more striking theories as to the manner in which flight has been acquired, having, of course, especial reference to Archæopteryx. I feel, however, that it would be wiser to leave this matter for a future paper. This course is the more advisable, since it is hardly possible to enter upon a discussion of this nature without taking into consideration the whole skeleton. Already I have found it difficult at times to confine myself to the narrow limits of the title of the paper. In such a discussion the reptilian affinities of Archæopteryx, real and imaginary, would necessarily take a large share, and this would mean straying from the point at issue as well as doubling the length of the article itself.

REFERENCES.

1. **Dames, W.**—"Ueber Archæopteryx." *Palæont. Abhandl.*, Bd. ii., Heft 3; 1884.
2. **Dollo, L.**—"L'Archæopteryx." *Revue quest. Scient.*; 1885.
3. **Evans, J.**—"Portions of a Cranium and a Jaw." *Nat. Hist. Review*, vol. v., p. 415; 1865. A reprint issued in 1881, p. 5.
4. **Fuerbringer, M.**—"Über das Schulter-und-Ellenbogengelenk bei Vogeln und Reptilien." *Morph. Jahrb.*, Bd. ii., p. 118; 1885.
5. **Gadow, H.**—"Bronn's Klassen und Ordnungen des Thierreichs." Anatomischer Theil, pp. 75, 503, 566; 1891. Systematischer Theil, p. 88; 1893.
6. **Hurst, C. H.**—"Biological Theories, VII. The Digits in a Bird's Wing." NATURAL SCIENCE, vol. iii., p. 275; 1893.
7. **Huxley, T. H.**—"Remarks upon *Archæopteryx lithographica*." *Proc. Roy. Soc.*, xvi., p. 243; 1868.
8. ——————"American Addresses." Lecture II., pp. 57–69; 1876.
9. ——————"Anatomy of Vertebrated Animals." P. 291; 1871.
10. **Koken, E.**—"Die Vorwelt." P. 369; 1893.
11. **Leighton, V.**—"The Development of the Wing of *Sterna wilsoni*." *Amer. Nat.*, vol. xxviii., p. 161; 1894.
12. **Marsh, O. C.**—"Jurassic Birds and their Allies." *Amer. Journ. Sci.*, ser. 6, vol. xxi., p. 318; 1881.
13. **Morse, E. S.**—"Tarsus and Carpus of Birds." *Ann. Lyceum Nat. Hist. New York*, vol. x., p. 141; 1874.
14. **Owen R.**—"On the Archæopteryx of Von Meyer, &c." *Phil. Trans.*, vol. cliii., p. 33; 1863.
15. **Parker, W. N.**—"Elements Comp. Anat. Vertebrates." P. 106; 1886.
16. **Pycraft, W. P.**—"Wing of Archæopteryx." *Journ. Oxford University Junior Scientific Club*, no. 12, p. 172; 1894.
17. **Romanes, G. J.**—"Darwin and After Darwin." 1892.
18. **Rosenberg, H.**—"Ueber die Entwicklung des Extremitäten-Skelets." *Zeitschr. wiss. Zool.*, vol. xxiii., p. 142; 1873.
19. **Seeley, H. G.**—"On Carl Vogt on Archæopteryx." *Geol. Mag.*, Dec. 2, vol. viii., pp. 300; 1881.
20. **Vogt, C.**—"*Archæopteryx macrura*." *Revue Scientifique*, ser. 2, tom. 9, p. 241 1879.
21. **Woodward, H.**—"On a Feathered Fossil from the Lithographic Limestone of Solenhofen." *Intellectual Observer*, Dec., 1862, pp. 317 and 319.
22. **Zittel, K. A.**—"Handbuch der Palæontologie." i. Abth. Palæozoologie, Bd. iii., Lief. 4; p. 821; 1890.
23. ——————"Archæopteryx ein Zwischenglied zwischen den Vogeln und Reptilien." *Der Naturforscher*, no. 42, p. 401; 1879.

Oxford. W. P. PYCRAFT.



ARCHÆOPTERYX.

FROM a photograph of the specimen now in the Berlin Museum, ⅔ natural size. Reprinted from "Lectures on the Darwinian Theory," by A. Milnes Marshall, with the kind permission of Dr. C. F. Marshall, at whose special request the figure is printed in the reverse position to that in which it is usually presented.

IV.

Pseudo-Biology.

OF all the pseudo-sciences that flutter abroad in this *fin de siècle* and attempt, often with too much success, to inveigle the unwary, none is so popular, none so fatally attractive, as that whose professors preach from the pseudo-biological pulpit. It is because it deals so largely with an assumed biology in its bearings on the conduct and progress of our selves, our nation, and our race, that it attracts us first, and that if we follow its will-o'-the-wisp, we founder in ignominious error. Its vogue is also great because so many of us poor mortals are wandering around in the darkness, having deserted the hand that formerly guided us and still searching for another; then to us wanderers there appear evangelists of a new gospel, which is superficially intelligible, and which we readily accept because we really understand it no more than do its preachers.

There has been lying on our table for some months, now looked at and now cast aside, a book by that extraordinarily popular Professor of this subject, Mr. Henry Drummond. It has been on our minds, at intervals, to give some review of this book, but we have never been able to decide whether we should be warranted in devoting any of our space to its consideration. And we only do so now in response to the request of numerous correspondents, whose minds seem, not unnaturally, to have been disturbed by the diverse criticisms that this work has called forth.

The title of the work in question is "The Lowell Lectures on the Ascent of Man." The Lowell Lectures are, we believe, delivered in Boston, one of the chief intellectual centres in the United States; and we doubt not that the audience attending them would be worthy of any lecturer in the world. Remembering this, we have, often and often as we perused Mr. Drummond's pages, wondered with a mirthful and a sorrowful wonder to think of our cultured Bostonian friends and the keen youth of Harvard sitting in solemn rows, agape and aghast at the meretricious and fallacious periods of this pseudo-biological pulpiteer. What did the cute sophomores from Cambridge make of this marvellous utterance?—"Run the eye for a moment up the scale of animal life. At the bottom are the first animals, the Protozoa. The Coelenterates follow, then in mixed array, the Echinoderms, Worms, and Molluscs. Above these come

the Pisces, then the Amphibia, then the Reptilia, then the Aves, then—What? The Mammalia, THE MOTHERS. There the series stops. Nature has never made anything since . . . the one motive of organic Nature was to make Mothers. Ask the Zoologist what Nature aspired to from the first, he could but answer Mammalia—Mothers." And so on. Surely, like the old maid in the story, those young men from Harvard shouted back to the Professor, "SPEAK FOR YOURSELF, SIR!"

But, after all, there are many worthy people, especially among the purchasers of Christmas booklets, who adore Mr. Drummond's eloquence, so we will not mar the goodwill of the season by over-insistence on our own squeamishness. Only, if the odious comparison be for a moment allowed, we would venture a word of praise for the sober and lucid style of the professor's rival in this field, Mr. Benjamin Kidd. A book may be written well or ill; its solid scientific or, if you prefer it, theological merit is not thereby affected. It is when rhetoric usurps the place of reason and leads to an irreverent disregard of truth that we have a right to complain of its abuse. And it cannot be denied that there are in this book many mistakes, perhaps of no great importance, but which, when found in the writings of a professor, it is kinder to ascribe to rhetoric than to ignorance. Here is a curious instance (p. 14), "The man who is busy with the stars will never come across Natural Selection, yet surely must he allow for Natural Selection in his construction of the world as a whole. *He who works among star-fish will encounter little of Mental Evolution*, yet will he not deny that it exists." We should think not, indeed. Has Mr. Drummond ever heard of G. J. Romanes, whose work "Jelly-fish, Star-fish and Sea Urchins" was distinctly subservient to his work "Mental Evolution"? Here is another case, more patent and less excusable (p. 240), "The Birds took one road, the Vertebrates another; the Vertebrates kept to the ground, the Birds took to the air." There are, it is true, people who still insist that "an animal" must have four legs and a tail; but surely even a Professor of Pseudo-biology might be expected to put the Birds among the Vertebrates. Here again are two statements, either of which is questionable, but which, occurring in adjacent chapters, also involve a contradiction: on page 245 it is written, "The first law of Evolution is simply the first law of motion. 'Every body continues in a state of rest, etc.'"; but on page 309 it is written, "The first commandment of Evolution is 'Thou shalt mass, segregate, combine, grow large.'" We hope that Mr. Drummond is obeying the former rather than the latter, we had liefer see him in a state of rest than growing large.

Mr. Drummond will complain that we are trifling with him and not arguing. That is so; but then Mr. Drummond should not trifle with us. The lapses to which we have referred will mislead no sensible person; it is merely inexcusable that a sensible person should

be subject to them. But there are other erroneous statements, which often form the bases of arguments, and which would naturally deceive the lay reader. The following sentence (p. 22) is an important link in one of Mr. Drummond's main chains of argument, viz., that proving Altruism to be the "direct outcome and essential accompaniment of the reproductive process." The sentence is, "Without some rudimentary maternal solicitude for the egg in the humblest forms of life, or for the young among higher forms, the living world would not only suffer, but would cease." There are sea-urchins that carry their young in a little pouch on their backs, there are fish that make nests, there is a toad whose back is pitted with cells in which the little toads develop; but where is the maternal solicitude in the common *Echinus*, in the fishes of the sea, or in the frogs of the marsh? No one would deny maternal care to be a great aid in evolution, serving as it does to transmit the experience of a lifetime; but it is stretching a good many points to say that "for a time in the life-history of every higher animal the direct, personal, gratuitous, unrewarded help of another creature is a condition of existence." One begins to suspect that this professor of pseudo-biology has never seen so much as a tadpole. Then again, in the chapter on the evolution of language, we are treated to this remarkable pronouncement, "Any means by which information is conveyed from one mind to another is Language. And Language existed on the earth from the day that animals began to live together. The mere fact that animals cling to one another, live together, move about together, proves that they communicate." So doubtful is this that one might even take so highly developed an animal as the Rosy Featherstar of our seas, and ask Mr. Drummond what real proof he has that the individuals of its floating colonies communicate with one another.

The preceding instances should show the admirers of this latter-day pamphlet-writer that they ought to be careful in accepting his premises as gospel-truth. And if they are not yet convinced, let them ask some biological friend what he thinks of the following observations. "It is one of the most astounding facts of modern science that the first embryonic abodes of moss and fern and pine, of shark and crab and coral polyp, of lizard, leopard, monkey, and Man are so exactly similar that the highest powers of mind and microscope fail to trace the smallest distinction between them" (p. 79). Astounding indeed! Small wonder that in the description of the development of the human embryo which immediately follows, Professor Drummond definitely introduces the formation of a gastrula by simple invagination. This prepares us for the description of the simplest case of cell-division, on p. 282, "At one moment it will call in matter from without, and assimilate it to itself; at another moment . . . it will set a portion of that matter apart, add to it, and finally give it away to form another life. Even at its dawn life is receiver and giver; even in protoplasm is Self-ism and Other-ism." The only difficulty is

that, let Professor Drummond study his divided cells for ever so long, he will never be able to tell us which is the Self and which is the Other—

> For each of them is born a twin,
> And not a soul knows which.

Or what will the biologist say when, to impress upon us his idea that all sociability depends on Sex, Professor Drummond writes, "There is no instance in Nature of Division of Labour being brought to such extreme specialisation" as in the evolution of Sex? He will remind us of the colonies of jelly-fish, in which some individuals do nothing but swim, others nothing but eat, others nothing but produce their kind, while one serves as a swollen bladder or float to support the whole colony; or of the coral-like colonies, where some individuals are mouths and some are only fingers to feed the mouths; or of the sea-mats, in which some of the polyps in a colony are nothing but tweezers to hold on to the food, while the other individuals eat it; or if colonial animals be put out of court, he will adduce the ants, with their castes of soldiers, workers and the rest, and the bees, with workers and drones and a single queen. All this specialisation has nothing to do with Sex, and yet in many cases Mr. Drummond's very words are applicable; each individual has "so entirely lost the power of performing the whole function that, even with so great a thing at stake as the continuance of the species, *one* could not discharge it."

This last quotation and the criticism of it that any biologist might be expected to offer, lead us directly to Mr. Drummond's main argument, "the fundamental omission," as he calls it, from all previous theories of the world, and also show us how greatly Mr. Drummond has overstated his case. We are told in the first place that all except a few powerful intellects, such as "Le Conte, Mr. Herbert Spencer, Romanes, Miss Buckley, and Prince Kropotkin," have taken the Struggle for Life to be the all-important factor in the Evolution of living beings. Drummond (let us drop the unnecessary "Mr.") insists that the Struggle for the Life of Others is equally important. The Struggle for Life is connected with the function of Nutrition, with the struggle for food, which alone has been considered heretofore. The Struggle for the Life of Others depends absolutely on the function of Reproduction. This great discovery, which is to "readjust the accents," must have occurred to Drummond very shortly after reading a book, not altogether unknown, entitled "The Evolution of Sex," and written by those original thinkers and writers, Patrick Geddes and J. Arthur Thomson. To insinuate, or even to suppose, that our leading writers on these subjects have overlooked the principle of altruism throughout the animal kingdom, evidences a remarkable state of mind. Everyone has long recognised it, and everyone would be prepared to grant to the various actions of animals grouped around reproduction, whether the attraction of the male to the female, or the tending of the offspring by the mother, a large share in the fostering of an altruistic

spirit. But Drummond rides a willing horse too hard. He tries to make his phrase cover many things to which it is not applicable. What does he mean by the "Struggle for the Life of Others"? On page 39 it appears to mean nothing more than the struggle to produce, the tendency to grow fat and multiply. But this is not an obvious meaning of the phrase. The fact is that, in ascribing all animal acts to the two functions of nutrition and reproduction, Drummond overlooks the inner impulse of life that pervades all living beings, the joy of life, so wonderfully described by Mr. Hudson in "The Naturalist in La Plata," the Over-Soul as Emerson calls it, the excess of vitality that is the very spur to sexual love and the essence of all reproduction. There is no "Otherism" here; it is the intensest of "Selfism." There is hardly a passion in all animal life so purely selfish as this one, which Drummond places at the base of the Struggle for the Life of Others. Moreover, this Over-Soul it is that produces over-population, which is the great goad of progress. But this is the very thing that makes the Struggle for Life keen, and he is either very bold or very foolish who would try to capture this for the side of Altruism.

Surely the truth is, what we thought everyone recognised long since, that the altruistic principle springs chiefly out of the gregarious habit, which has not necessarily anything to do with reproduction. Regarded in this light the Struggle for the Life of Others is merely a development of the Struggle for Life itself. But here is the point which so many of these pseudo-biologists seem to miss. The individual is not the unit of evolution. The unit is the Species, and, as Mr. Kidd has so well pointed out, the interests of the species are directly opposed to the apparent and immediate interests of the individual. In the lower animals, where reason does not come into play, there is nothing to run counter to the forces that make for the progress of the species, and these have produced the subservience of individuals to the colony or tribe in those cases above referred to. Even in the human species, we should in many cases be inclined to reverse Drummond's idea (p. vii.) that Family life precedes the Tribe.

It is when we turn to rational man, that we see difficulties in the way of further altruistic developments. Man is an egoist as well as a gregarious and political animal. He is an individualist by reason, if not by nature. Mr. Kidd's point appears then to be this. Religion is neither true nor false, natural nor supernatural,—merely the apotheosis of the principle that governs the life of all herds, families, tribes, nations, viz., self-sacrifice and the subordination of the individual. The apotheosis of this altruistic principle gives it what Mr. Kidd calls a "sanction," which, so far as the individual is concerned, is "ultra-rational." The philosopher understands the drift of altruism, he sees its origin and its necessity. Not so the hungry man in the street or the forest. He needs something outside to keep him in the path of allegiance to the race. This is religion,

the "something not ourselves that makes for righteousness," which, whether false or true, as we now choose to understand falsehood and truth, has been the motive force in the rise of many nations and of vast empires. This is the force, strictly subordinate to the great principle of Natural Selection, and subject like all else in this world to the process of Evolution, this is the force that has worked side by side with the simple struggle for the life of the individual, to produce the world as we see it to-day, with its men and its women, its fathers and its mothers, its citizens and its patriots.

But Drummond understands neither this, nor Mr. Kidd, nor even Professor Huxley. Wresting from its meaning a sentence by the latter, he tells us (p. 4) that "Evolution is simply 'history' . . . neither more nor less than the story of creation." This is disingenuous: Evolution is more than this; it implies, as Huxley proceeds to say, "a series of genetic changes," "progressive differentiation," and "the growth and modification of primordial germs." "Evolution," says Drummond again on p. 20, "began with protoplasm and ended with Man." Who is this person, so ignorant of Laplace and Kant, of Lockyer and Crookes? Who is this presumptuous prophet that sets a limit to the thoughts of God? After this we do not wonder that every thesis of this chatterer should be vitiated by his idea of his own self-importance. *He* knows the end of Creation, and so he tells us that, "the beginning must be interpreted from the end": the cart, with Professor Drummond holding the reins, must be put before the horse. We prefer to wait; the end is not yet.

With its cheap philosophy and its reading into the lower world all the passions and ideas of our own highly-organised consciousness, this book is a sad example of teleological argument. Teleology it is that causes Drummond to speak of "the gradual tempering of the Struggle for Life. Its slow amelioration, &c." The nature of the struggle changes, it passes to a higher plane; but the fight is not less keen, the pain not less bitter. Let this Professor in his chair contrast the social wreckage of our race, the tramp, the prostitute, the starving seamstress, with the jelly-fish stranded on the beach or the larvæ swallowed at a gulp by the monsters of the deep, and then let him dare repeat to a despairing world, that the harsher qualities of the struggle are passing away!

Our author is pledged by his preface to be original, and this is how he effects his purpose. "One has only to read the average book of science," he writes on p. 42, "to wonder at the wealth of knowledge, the brilliancy of observation and the barrenness of idea. On the other hand, though scientific experts will not think themselves, there is always a multitude of onlookers waiting to do it for them. Among these, what strikes one is the ignorance of fact and the audacity of the idea." "The Ascent of Man," then, is original because it falls under neither of these censures; for it combines "ignorance of fact" with "barrenness of idea." F. A. BATHER.

SOME NEW BOOKS.

The Naturalist in India.

A Naturalist on the Prowl, or in the Jungle. By Eha. 8vo. Pp. xii., 257. London: Thacker & Co., 1894. Price 8s. 6d.

"For their first introduction to the public," writes the author in his preface, "these papers are indebted to the *Times of India*." The editor of that newspaper is clearly a discerning person, and the author certainly cannot be mistaken in thinking that he "detected on the kind countenance of the public" much approbation of the articles—at least that is our opinion after reading this charming volume. "Eha," whoever he may be, has clearly some leisure which he has well spent in communing with nature in India. Nature in India is much more of a "rum'un" than she is at home here. She has produced, for instance, a serpent, the King Cobra; this *Ophiophagus*—whose bad example of eating other snakes has been recently followed at the Zoo by the Boa, proving the adage that evil communications corrupt good manners—is one of the few wild beasts that will deliberately go out of its way to attack a man. The power of the human eye may be a delusion, but there are not many wild animals that take the initiative in declaring war upon our species. The particular Hamadryad upon which nearly a chapter of the book is written was discovered coiled up upon a tree, and was at first asserted by the natives to be a Python. The reason for this varnishing of the truth was that the native preferred that "Eha" should dislodge the brute. A glance at the face of the reptile at once dispelled the python theory. "A python's eyes look nowhere in particular," we are told, "this creature's eye met mine with a truculent stare like nothing I had seen before." Some more information about the Hamadryad is given which runs as follows: "On the way I learned some things about the King Cobra which are not generally known. So swift is it that, when it pursues, escape by flight is impossible. When it has caught a man it swallows him whole, then climbing a tree, it winds itself round the trunk and tightens its coils until the man is crushed all to nothing in its inside. Thus it digests him. Facts like these are becoming increasingly rare in books. You must glean them among the simple folk who spend their lives with the beasts of the field and from infancy hold converse with nature's charms and view her stores unrolled. I have gathered many such very wonderful and known to few." It is not often, we must add in bare justice, that "Eha" is so newly-humorous as in the above passage.

A chapter entitled "The Voice of Mirth" gives the author the opportunity of saying something about the Cicada. The present writer has himself heard the "protracted ear-rending scream" of this insect, which is far worse than that of any other insect known to

science. Here it is the male who indulges in the shrill music. "Happy is the Cicada," as the ancient and misogynistic philosopher remarked, "in that he has a voiceless wife." "Cherchez la femme" is the explanation that the author, unlike others, is not altogether disposed to adopt in explanation of the sounds. He thinks that the vibration caused to the body by the noise is probably pleasing to the Cicada himself, and that he sings purely for his own amusement. It has been remarked that in the east there is no object in the sluggard fatiguing himself by going to the ant; the ant comes to him in some force. Chapter xvii. commences with one of Mr. Sterndale's excellent and humorous sketches of the author in the very act of grappling with ants upon his neck and ants upon his leg. The red ant of the east is one of the drawbacks to residing there. A study of the ways of this particular species is not conducive to the reception of moral lessons of any great value. They wait for you, "dancing with excitement on the point of every prominent leaf," as you take your walks abroad; the older members of the community have even, according to "Eha," an accurate anatomical knowledge of the human body, and at once make for such points as are more especially tender. Everybody knows that in this country there are ants which foster Aphides in order to feed upon the sweet secretion produced by them. The little black milkmaids throng round the little green cows, tap them gently with the antennæ, and drink up the milk which they then furnish. The red ants in India keep a butterfly caterpillar of more than an inch long for the same purpose. In gratitude for past favours, the chrysalis is carefully watched over, and the resulting butterfly allowed to fly away in perfect safety.

This is a sample of much new and readable information.

INDIAN GEOLOGY.

A MANUAL OF THE GEOLOGY OF INDIA. Chiefly compiled from the Observations of the Geological Survey. Stratigraphical and Structural Geology. Second Edition. Revised and largely re-written by R. D. Oldham.[1] Calcutta, 1893 (received 1894). 8vo. Pp. xxiii. and 543, with folding map, 23 plates and 27 figures.

BLANFORD & MEDLICOTT'S "Manual of the Geology of India" has long been an ideal book of its kind. Detailed descriptions of the geology of extra-European countries have been issued in a separate form far too infrequently. The geologist, and especially the palæontologist, who has occasion to refer to some point in the stratigraphy of such a country has, as a rule, to search through numerous scattered memoirs for the simple fact he needs. Moreover, probably most geologists enjoy the occasional perusal of the description of some country if written as a connected story, and not in a series of scattered memoirs, dealing with local details. The publication, therefore, of a general account of the geology of India was an act for which all geologists must have felt grateful to the authorities of the Geological Survey of that country. The first two volumes, which contain the general stratigraphy, were issued in 1879, and have ever since served as indispens-

[1] We understand that a new title-page has been issued, owing to the omission of the names of the two original authors, Messrs. Blanford and Medlicott. For this, however, we understand Mr. Oldham was not responsible. He had inserted the names of the two original authors. He also enables one to see at a glance how much credit is due to Messrs. Blanford and Medlicott by printing, in the list of contents, the titles of all paragraphs taken from the former edition in different type to that used for those for which he has contributed.

able books of reference, and as models of what this sort of work should be. The fact that they have been out of print for some years showed how well they did what they were planned to do. Great progress has meanwhile been made in the geological survey of India, and a new edition, brought thoroughly up-to-date, was therefore much to be desired. The preparation of this was entrusted to Mr. R. D. Oldham; his "Bibliography of Indian Geology" (1888) suggested him as the most suitable man for the task, since a thorough acquaintance with the literature of the subject was one of the most essential qualifications. Mr. Oldham, moreover, has shown in numerous contributions to the *Records* and *Memoirs* of the Indian Survey, and in his recent sketch of "The Evolution of Indian Geography" in the *Geographical Journal* (March, 1894), that he is thoroughly in sympathy with the enquiries regarding the past physical geography of the country. And consideration of these is probably the only method of compiling a work that shall be interesting to read as well as valuable for reference.

In comparison with the former edition, the present has many advantages; it is issued as one volume instead of two; the scale of the map is reduced by about a third, and is, therefore, handier of reference, though there is more information in it; the long glossary is omitted; a most useful novelty is introduced in the index of localities, which occupies 32 pages; the latitude and longitude of each place is given, so that those unacquainted with the details of Indian topography can follow the descriptions with ease. The greatest improvement, however, is the abandonment of the system of describing the country in provinces; this method of treatment was no doubt inevitable in 1879, when the correlation of the rocks in the different regions was much less advanced than at present. The fact that description by formations instead of by provinces is now possible is one of the principal measures of the progress effected, which this volume attests. It is owing to this change that the work has been rendered more compact, for there is now one story instead of many.

In the list of contents Mr. Oldham has adopted the useful plan of printing in heavy type the titles of all those paragraphs which are either quite new or have been almost entirely rewritten. This, besides showing how much is to be credited to the original authors, directs attention to the subjects on which most work has been done in the interval between the two editions. Thus we see at once that little has been added to our knowledge of the pre-Palæozoic, the Palæozoic, the marine Jurassic, and the Cretaceous rocks of the Peninsula, or of the Deccan Traps. We note the absence of fresh information on the last of these with regret, for though Dr. Blanford's sketch of the subject (chap. xi.) is an admirable one, there are many points in the detailed stratigraphy, and especially in the petrography, on which further information is most desirable. In fact, in most of the Peninsular area, the facts remain much as they were, the principal additions being made to the knowledge of the correlation of the rocks with other areas in Asia, Africa, and Australia. Thus the description of the stratigraphy of the Gondwana system remains practically the same as before, though the chapter on the homotaxis of this formation is almost wholly new or rewritten. The fact that the great controversy as to the true correlation of this system is now at an end is noted with relief.

The principal changes in the volume are in chapters viii., xviii., and xix., which are entirely rewritten or new. The first is the one

already alluded to, dealing with the correlation of the Gondwana system. The other two summarise the evidence as to "The Age and Origin of the Himalayas," and give a sketch of the "Geological History of the Indian Peninsula." Attention is paid to the recent discussions upon the former, and the effort to prove that the Himalaya are of only very late Tertiary age, and that they are even now undergoing elevation. It is, however, maintained that the old view that the Himalaya are post-Eocene and pre-Pliocene is the correct one. The contentions of Middlemiss that the mountains were partially formed in pre-Tertiary times is also dismissed, but here the evidence is apparently less conclusive; the discussion of the subject leaves one with the impression that perhaps Mesozoic movements in the area were more important than has been believed. In discussing the formation of the Himalaya, attention is called to the Rev. Osmond Fisher's theory of mountain structure; a modification in this is proposed, and with this alteration the theory is said to find much support and illustration in the facts of Himalayan geology.

One of the most interesting points in which this edition differs from its predecessor is the different conclusion arrived at in respect to the formation of the Western Ghauts or Sahyadri Mountains. These are unlike the hills on the eastern side of the peninsula, which were grouped together in old geography books under the name of the Eastern Ghauts. For the Sahyadri Mountains have long been known to have a unity of structure, and to be of comparatively recent age. The hills on the Madras side of the peninsula, on the other hand, are not a single range, and were, with the Aravalli Mountains in Rajputana, among the oldest geological features in the country. In the 1879 edition the conclusion was maintained that the western scarps of the Sahyadri Mountains were formed by marine denudation, and were carried back some distance into the Tertiary rocks. Mr. Oldham, however, maintains that these mountains are the newest feature in Indian geography, and that their abrupt western scarps are the direct result of a dislocation. His arguments, moreover, seem absolutely conclusive as to the truth of this interesting and important view.

A charming photo-gravure of the eastern spur of the famous peak of Kanchanjanga (or Kichinjunga as it is probably better known in England) forms a frontispiece to the volume. This is so good that one wishes some more photographs of Indian scenery had been given in the book. We should have been glad to have seen some of the plates of fossils replaced by some of the photographs which have adorned recent volumes of the Indian Survey *Memoirs*. In a general book of this character, these would probably have been found of more general use and interest than figures of fossils.

Mr. Oldham is to be congratulated on the completion of his laborious task of revision, and we hope when a third edition is required the task will be placed in the hands of one who will do it with as much knowledge and originality.

J. W. G.

AMPHIOXUS.

AMPHIOXUS AND THE ANCESTRY OF THE VERTEBRATES. By A. Willey, B.Sc. Pp. xiv. and 316, with one plate and 135 illustrations, being Vol. II. of the Columbia University Biological Series. New York and London: Macmillan and Co. Price 10s. 6d. nett.

THE literature of *Amphioxus* is not so large as that of many other groups; but it is nevertheless of a decidedly respectable bulk, particularly if various papers which bear indirectly upon the problems

which the structure of this animal gives rise to are included. Mr. Willey quotes no less than 133 papers which have been consulted by him in the course of preparing the volume now before us, and of these at least 100 may be fairly put down to *Amphioxus* itself. It is therefore a saving of much time to the hard-worked zoologist of the present day to have all this in a nut-shell—a cocoa-nut-shell possibly,—but still a work of moderate dimensions. Apart from this merit, the practice of writing a book about a definite animal of interest seems to us to be an excellent plan. It is a pity that not more is done along this line, which was really initiated by Mr. Huxley in his "Crayfish." The anatomy of birds, for example, might be woven into a volume upon such a type as *Apteryx*, one upon the Amphibia upon a plain account of the Axolotl, and so forth.

The present work contains everything that should be known about *Amphioxus*, besides a great deal that it is advantageous to know about the Tunicata, *Balanoglossus*, and some other types which come into structural relations with *Amphioxus*. *Amphioxus* was originally put down as a Mollusc, a fate which also overtook another equally remarkable and not less isolated type, *Peripatus*; the Mollusca in the early days of this century and the last days of the seventeenth appear to have been pretty well what the worms are now, a receptacle for anything unclaimed. The Russian naturalist Pallas, the discoverer of the "fish," was responsible for this placing of it; it was not until sixty years had elapsed that Costa redescribed *Amphioxus* and put it in its proper place, approximately at any rate. Nowadays there are really two parties which surge round *Amphioxus*; there are those who would look upon it as much degenerate and those who regard its simplicity as a mark of antiquity. There is no doubt much of both in the organisation of the animal. This "exquisite form," as Professor Osborn enthusiastically calls it in the preface which he contributes to Mr. Willey's book, is common in many parts of the world; it is, indeed, practically world-wide in range, or is represented by a considerable number of species which differ in but slight characters, the number of the myotomes being the chief means by which they are distinguished. Mr. Willey argues from its wide range and the trifling specific differences that the form is extremely ancient. We fully agree with Mr. Willey that the creature is in all probability an extremely archaic form, but his reasoning does not seem to us to prove the fact. In ancient forms it is surely more usual for the differences between species, or genera, as the case may be, to be great rather than small; intermediate forms have had time to die out, and long isolation has done its work. It is, rather, the newer groups that fade imperceptibly into each other. The very fact that there are so many diverse opinions about the classification of birds is indirect evidence of the comparative newness of the group; while the strikingly marked lines which divide from each other the several groups of reptiles are confirmatory of their age as shown by the rocks. The number of described species of *Amphioxus* is eight, but we believe that a ninth species was described at the recent meeting of the British Association at Oxford.

Amphioxus is, as will be inferred from what we have said concerning the bulk of the literature devoted to it, one of those animals which most naturalists have had dealings with. It is surprising, therefore, to learn how recently the excretory system has been discovered. For a long time the animal was believed to be without any specialised excretory organs of the vertebrate type—a piece of evidence which appeared to

indicate its degenerate character. But now, thanks to the investigations of several workers, we are in full possession of the details of the excretory system, which has been proved to be constituted on the plan of that of other Vertebrata, but, of course, with differences in details. The excretory tubes of the *Amphioxus* appear to represent the "head-kidney" or pronephros of other vertebrates. But they have no continuous longitudinal duct such as exists in all other types. The place of this is, however, physiologically taken by the atrial cavity, into which the series of tubes opens. It is now the general opinion that the longitudinal duct of the pronephros in the higher vertebrates is a formation from the epiblast—a groove to begin with, which is later converted into a tube; since the atrial cavity is also an epiblastic formation, no great gap is indicated by the absence of a special longitudinal duct.

It is, however, rather the comparisons with lower forms of life that are so interesting in *Amphioxus*. The connecting link between vetebrates and invertebrates has been long sought, and in spite of *Amphioxus*, Ascidian, *Balanoglossus*, or even the latest claimant, *Cephalodiscus*, it has not yet been found. For as all the animals which have been mentioned show the three essential Chordate characters, the dorsal nervous system, the notochord, and the gill-slits, we are really no further than we were before, and there is still hope for the Annelid to put in a claim which will be admitted. Mr. Willey gives, in his introductory remarks, an excellent *resumé* of the celebrated opinion of Geoffrey St. Hilaire upon the matter. The boldness—yet, so far as it went, logic—with which that great naturalist compared the exoskeleton of an insect with the ribs and vertebral column of a fish, have been equalled, if not surpassed—at any rate, so far as regards the boldness—by modern comparisons of Crustaceans and *Limulus* with vertebrates. Of the three essential chordate characters, the gill-slits would seem to be the hardest to account for; the existence of breathing-organs as mere processes of the skin seems so natural as it is very widely spread. There has, however, been a suggestion made, which is duly quoted by Mr. Willey, and which seems to shed at least a pin-point of light upon the matter. Mr. Harmer and Mr. Brooks have thrown out the hint that the function of the gill-slits was originally that of getting rid of the superfluous water; a form like *Cephalodiscus*, with copious arborescent gills, would appear to have no need of aërating the blood in the other, so to speak, far-fetched manner. And yet *Cephalodiscus* has gill-slits. The only invertebrates not within the charmed circle of the forms already referred to, which are seriously considered by Mr. Willey, are the Echinoderma and the Nemertines. The former group come in, of course, through the likeness of their larva to the *Tornaria* larva of *Balanoglossus*, as was fully explained in our October number, on p. 245 of this volume. The Nemertines have a proboscis sheath, which Professor Hubrecht compared to the notochord, and a pair of nerves which tend to become approximated dorsally, and therefore to occupy the position of the central nervous system of the vertebrate. Mr. Willey, however, at the conclusion of his book, feels unable to do more for the vertebrate pedigree than to suggest "that the proximate ancestor of the vertebrates was a free swimming animal, intermediate in organisation between an Ascidian tadpole and *Amphioxus*. . . . The ultimate or primordial ancestor of the Vertebrates would, on the contrary, be a worm-like animal, whose organisation was approximately on a level with that of the bilateral ancestors of the Echinoderms."

Index Kewensis.

Towards the end of October the third part of Jackson and Hooker's "Index Kewensis" appeared. This part ranges from *Kiblikia* to *Psidium*, and includes the large and difficult genera of grasses, *Paspalum*, *Panicum*, and *Poa*, the synonymy of which is most complicated, and for which there has been no guide beyond the unsatisfactory monograph of Steudel. The volume bears the signature "Vol. II.," and is paged 1–640. We do not see any advantage in this new pagination in the middle of a reference book, as it only causes trouble in quotation. The work has already been referred to at length in this Journal (Natural Science, iii., p. 379), and all we need do now is to express our admiration at the rapidity with which the Oxford University Press and Messrs. Jackson and Hooker are passing their proofs through the press.

The "Orient Guide."

This new edition of the "Orient Guide" is the fifth, the first having been issued in 1884. As each edition has consisted of from 10,000 to 15,000 copies, there must be a good many "Orient Guides" scattered about in the world. In the present issue a considerable number of alterations are to be found, some, but not many of them, being improvements. The opening chapter is no longer an account of the principal ships, but an essay by the newly-knighted Sir Wemyss Reid on ocean travelling in general. The medical chapter is omitted, as are Mrs. Henry Fawcett's delightful notes on Italy and Germany. Nearly as interesting was Mr. W. B. Richmond's account of Greece, of which only the Athens fragment remains. An account of the Australian colonies by Mr. Matthew Macfie has been added, and forms an attractive feature. Mr. Middleton Wake's exhaustive list of birds likely to be seen at sea is supplemented by a short description of Australian zoology. There seems to be some confusion on p. 257 between Bauer's parrakeet and Barnard's, whose name is spelt wrongly as Bernardius. There is quite a little treatise on the mariner's compass, a difficult subject, but clearly and simply explained by Commander Hull, R.N. The Rev. W. J. Loftie, the editor of the volume, must have had a laborious task in cutting and fitting together the varied mass of information of which we have given a brief epitome. He is to be congratulated upon the compact result.

Mr. J. W. Taylor is publishing a Monograph of the Land and Fresh Water Mollusca of the British Isles, of which the first part has just been received by us. It contains abundant illustration, and each part will be sold at the moderate cost of five shillings. The leading malacologists have been freely consulted in preparing the volume, which will doubtless be found of great use. In the circular which we have before us, some MS. opinions of eminent naturalists, such as the Rev. Canon Norman and the Rev. A. H. Cooke, are quoted. We hope to review the first volume when completed.

The first volume of the Cambridge Natural History is to appear, we are informed, either before or just about Christmas. This is to be upon the Mollusca, and is written by one of our foremost authorities on the group, the Rev. A. H. Cooke. The recent Brachiopoda are to be treated of by Mr. Shipley, one of the editors of the work; the fossil Brachiopoda by Mr. F. Cowper-Reed; the Polychaet worms by Dr. Benham; the Oligochaetes by Mr. Beddard, and other groups by other specialists.

Messrs. Swan Sonnenschein & Co. advertise a second edition of Mr. Beddard's "Animal Coloration," which appears to be a simple reprint without any further additions.

Some Recent Journals and Pamphlets.

On November 1 our contemporary *Nature* attained its twenty-fifth birthday, and started its fifty-first volume with a leader by Professor Huxley, in which he points out the remarkable effect of Darwinism on Natural Science. Professor Huxley wrote the first article in *Nature* when it first appeared as a weekly newspaper in 1870, and the present editor has just cause to congratulate himself on the fact that so distinguished a send-off has again been accorded to him.

Another contemporary, the *Feuille des Jeunes Naturalistes*, also proudly announces that it starts its twenty-fifth year of publication with the November 1 number. We congratulate Mr. Adrien Dollfus on the success which has crowned his energy and enthusiasm. Besides a paper by the editor on the Idoteidæ (Isopod crustacea) of the French coasts, there are others on the noxious insects of the Pines in Champagne by R. Hickel, and a long account, by H. Hua, of the recent Congress of the Botanical Society of France.

The Geological Society has just issued the fourth part of the fiftieth volume of its *Quarterly Journal*. It is a number of which any society might be proud, and forms a fitting conclusion to the fifty volumes that are to be indexed by the Society. The part consists of eleven papers, illustrated by sixteen plates, of which no less than six are exclusively palæontological, and all this quite apart from the "Additions to the Library," which forms the subject of a special paragraph in our "Notes and Comments." Of the papers themselves the most interesting, perhaps, are Dr. Gregory's observations on the Glacial Geology of Mt. Kenya, in which he shows that the glaciation has had a much greater extent formerly than now, and has in no inconsiderable manner determined the geographical distribution of animal and vegetable life. African geology is much to the fore, for there is a long paper by Captain Lyons on the Libyan desert, and two other papers by Mr. Draper on the Geology of South-Eastern Africa. Petrology is represented by papers on the older fragmental rocks of North-West Carnarvonshire, by Professor Bonney and Miss Raisin; on the structures of the Carboniferous Dolerites and Tuffs of Derbyshire, by H. H. Arnold-Bemrose; and on the banded structure of Tertiary Gabbros in Skye, by Sir A. Geikie and Mr. Teall. Some interesting plates accompany the two last-mentioned papers.

In Palæontology, Mr. Peach writes on additions to the fauna of the *Olenellus*-zone of the N.W. Highlands. This is a paper of the greatest interest and value. After a few words as to the locality, Mr. Peach describes the fossils, of which the following are new: *Olenellus reticulatus*, *O. gigas*, *O. intermedius*, and *Olenelloides*, a new genus with species *armatus*. Four beautiful plates by F. H. Michael illustrate the paper. The second palæontological contribution is that of Frederick Chapman on the Microzoa of the Bargate Stone, a series he has worked out, described with considerable care, and illustrated with two plates. Seven of the Ostracoda and eleven of the Foraminifera are described as new. Mr. Chapman notes that this comparatively large number of new forms is due to the fact that the Bargate series belong almost exclusively to the Laminarian and

Coralline zones of the old Neocomian Seas. The part concludes with a paper by Mr. Gresley on Cone-in-Cone structure, as it occurs in the Devonian series of Pennsylvania.

THE September number of *The Journal of Marine Zoology and Microscopy* is in our hands, and appears to be fully up to the standard of other numbers of this useful periodical for the sea-side naturalist. There are four plates dealing respectively with the development of the *Balanus*, *Alcyonium*, and larval Ascidians, the anatomy of *Polynoe propinqua*, and the life-history of *Obelia geniculata*.

DR. PACKARD sends us a paper, anatomical and systematic, upon the Siphonaptera, more generally known as Fleas (*Proc. Boston Soc. Nat. Hist.*, vol. xxvi.). The paper is largely a *resumé* of the work of others, but it contains some original matter. The fleas, like most other animals, have been tossed about in the system. The general opinion about them, however, at the present day is that they are closely allied to, if not forming one order with, the Diptera. Professor Packard puts them a little further away from the two-winged flies than many do. But he decidedly thinks that "they stand nearer to the Diptera than to any other order, and that they must have diverged from the ancestral dipterous stem before the existing forms of Diptera had become so extremely specialised as we now find them to be." The paper, which occupies 43 pages, is copiously illustrated by cuts.

DR. A. G. BUTLER records, in the *Annals and Magazine of Natural History* for November, an amusing case of Walkerism—if we may so call it. It is the case of an unfortunate moth from Venezuela, which was described by Walker in vol. xv. of the British Museum Catalogue of Lepidoptera Heterocera under the name of *Celæna diffundens*. This same insect was described by the same author no less than six different times under six different specific names, and actually described under four of these names in one volume of the Catalogue (xxxiii.). As Dr. Butler truly says, "This kind of work needs no comment." But it is not an isolated instance.

IN the *Geological Magazine* for November Dr. Henry Woodward describes an interesting series of Carboniferous Trilobites from the upper Limestones, Bank of the Hodder, near Stonyhurst, Lancashire. These include two new species of *Phillipsia* (*P. vandergrachti* and *P. polleni*) and the types have, by the generosity of the College authorities and the discoverers, been placed in the British Museum. The same number of the *Geological Magazine* contains a photograph of an erect tree, *Sigillaria*, in the Coal-measures of the valley of the Roach, Rochdale, contributed by Mr. J. C. Brierley and Sir Henry Howorth.

DR. L. RHUMBLER has a note in the *Zoologischer Anzeiger* (September) in which he shows that *Peneroplis* belongs to the perforate rather than to the imperforate Foraminifera.

DR. JENTINK has published a catalogue of the Crommelin collection of Dutch Birds, now in the Leyden Museum. Full records as to age, sex, and locality are given, and the book should therefore be of considerable value.

OBITUARY.

NATHANAEL PRINGSHEIM.

BORN 1823. DIED 1894.

THIS famous German botanist, whose death was recorded in our last number, was born in 1823 at Wziesko, in Upper Silesia. Starting as a medical student in the University of his native province, he afterwards went to Leipzig, and later to Berlin. In the meantime, however, he decided to devote himself to botany, and it was a botanical thesis in which his Ph.D. was gained at Berlin. After taking his degree he visited Paris, and on his return commenced his career, in 1851, at Berlin University. Five years after, at the age of 33, he was elected Member of the Berlin Academy of Sciences. In 1864 he was called to Jena to replace Schleiden as ordinary Professor, an appointment he held for four years. During his stay in Jena he founded an Institute of Plant-Physiology, the first of its kind. The idea took, similar laboratories were established at other Universities and agricultural high-schools, and a tremendous impetus was given to the study of plant-physiology. In 1868 Pringsheim returned to Berlin, but did not join the teaching staff of the University. From his own resources he founded a botanical laboratory, and soon established a school, to which belonged Strasburger, Tschirch, Vöchting, and other well-known botanists.

Pringsheim's great work was on the sexual relations in Cryptogams, especially Algæ, following up the results of Thuret and others. In a series of researches on the history of growth in individual families, he showed the existence in the Algæ of widely different forms of sexuality and development. Another subject attacked by Pringsheim was Chlorophyll. He was the first to demonstrate the true relation between the green colouring matter and the protoplasmic corpuscle; as to the function of chlorophyll, he held a view the reverse of that generally accepted, namely, that the colour acts as a shade, absorbing those rays of light which promote destructive metabolism, and thus making possible the constructive process.

A biographical notice would be incomplete without mention of the familiar "Jahrbücher für wissenschaftliche Botanik," started in 1857 and continued up to the present. Pringsheim was one of the oldest foreign members of the Linnean Society, having been elected on May 3, 1866.

PIERRE DUCHARTRE.

BORN 1811. DIED 1894.

THE eminent French botanist who has just died was Professor of Botany in the Faculty of Sciences at Paris, a member of the Institut, and also a foreign member of the Linnean Society of London, having been elected on May 3, 1877. He was the author of numerous papers on plant-biology, including observations on the flower and its organogeny, germination, and the young seedling, among which we may recall some valuable contributions on polycotyledonous embryos, respiration, transpiration, the question of the absorption of water by leaves, the vegetation of epiphytic plants and teratological notes. In 1867 he published a large and valuable text-book, entitled "Elemens de Botanique," of which a second edition appeared in 1877, and a third in 1885. In 1868 he produced an exhaustive report on the progress of plant-physiology. He was also responsible for the fourth volume of Jacques and Heurincq's "Manuel des Plantes," a systematically arranged encyclopædia of plants in cultivation, or of interest from an economic point of view. In his younger days he edited for two years (1845–1847) a monthly periodical, the *Revue Botanique*, a series of abstracts of the chief botanical works published at home and abroad. He was led to undertake this onerous piece of work by Benjamin Delessert, but, as many another young and enthusiastic scientific worker has found, it meant giving up a very large proportion of time, and stopped scientific research. The death of Delessert in 1847 was therefore made the pretext for the cessation of the *Revue*.

GUILLAUME LOUIS FIGUIER.

BORN FEBRUARY 15, 1819. DIED NOVEMBER 9, 1894.

THE death of this eminent French chemist and naturalist is announced. Figuier was born at Montpellier, at which town his father Jean was a chemist. He received his doctor's degree from the Faculty of Medicine of Montpellier, and left for Paris, where he worked in the laboratory of the Sorbonne, under Balard. In 1846 he became professor to the School of Medicine at Montpellier, where he remained five years, retiring to Paris in 1852. Since 1855 he had charge of the scientific columns of *La Presse*, and subsequently of *La France*. In 1856–57 he attacked the views of Claude Bernard regarding the secretion of sugar by the liver, and this at once brought him into prominence. About this time, too, Figuier resigned his appointments, renounced scientific research, and devoted himself entirely to the popularisation of science. In this he was conspicuously successful, and his popular books enjoyed a large and well-deserved circulation. His best-known works are "La Terre avant le Déluge," 1863; "La Terre et les Mers," 1864; "Histoire des Plantes," 1865; "Les Zoophytes et les Mollusques," 1866; "Les Poissons,

les Reptiles, et les Oiseaux," 1867; and a long series of similar publications. In one of his later works he was concerned to uphold the immortality of the soul. Most of his books have been translated into the chief European languages. When, however, he attempted to teach science from the stage of the Cluny Theatre by means of a play, entitled "Les Six Parties du Monde," he met with a less hearty welcome. Figuier died at Paris, aged 75 years.

The distinguished oculist and microscopist, Ludwig Mauthner, died at Vienna on October 20, at the comparatively early age of fifty-five. After studying at Vienna, he went to Berlin and studied under Albrecht von Gräfe. His famous work, "Lehrbuch der Ophthalmoscopie," appeared in 1868. He also published "Die Bestimmung der Refractionsanomalien mit Hilfe des Augenspiegels" in 1867, and "Vorlesen über die optischen Fehler des Auges" in 1876. He was part editor of the *Archiv für Augen- und Ohrenheit Kunde* for some years.

The well-known collector of Fossil Fishes, the Rev. Hugh Mitchell, LL.D., died at Aberdeen, about the middle of the month. His chief collections were made from the Old Red Sandstone of Forfarshire, and included the forms known as *Acanthodes mitchelli*, *Ischnacanthus gracilis*, and *Climatius scutiger*. Sir Philip Egerton, Mr. Powrie, and Professor Ray Lankester largely drew upon his collections when writing their important monographs. His collections are now in the British Museum of Natural History, having been purchased last year.

The death of Mr. Oscar Koechlin, of Alsace, which took place in September, robs that district of an enthusiastic entomologist, and the Mulhouse Society of one of its original and most energetic members. Dr. B. N. Rake, who was elected President of the Trinidad Field Naturalists' Club on August 3, in succession to Mr. H. Caracciolo, died on August 24 at Port-of-Spain. Mr. Henry Tate, the acting Government analyst of the same island, also fell a victim to the prevailing malignant fever on August 18.

The news from Africa during the past month is very serious. Telegrams have appeared which record the deaths of the German botanist Dr. Lent, and the zoologist Kretzschmar, in the Kilimanjaro district, killed by natives, and of Mr. G. L. E. Andreæ, a member of a Belgian trading company, at Mukikamu, near Stanley Pool. Mr. Andreæ was an entomologist, and several parcels of insects have been sent by him from Africa.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

Dr. William Peterson has been appointed Principal of the McGill University, in the room of Sir William Dawson. Principal Dawson resigned about a year ago. Dr. Peterson has been for twelve years head of University College, Dundee.

Dr. P. L. Sclater has been elected an Honorary Fellow of Corpus Christi College, Oxford. He was formerly a Fellow of this, his old college.

Sir Thomas Temple, of Ballintemple, Wicklow, succeeds to the Vice-Presidency of the Royal Dublin Society. The office was rendered vacant by the death of the Right Hon. William Cogan.

Dr. Carl v. Heider, formerly an assistant in the Zoological Institute of Berlin University, has been appointed Professor of Zoology at the University of Innsbruck, and Dr. Michael von Lenhossek, Professor of Anatomy. Dr. von Lenhossek comes from Würzburg. Dr. R. von Lendenfeld has become Professor of Zoology in the University of Czernowitz; and Dr. Schewiakov leaves Heidelberg and goes to the Imperial Academy of St. Petersburg as assistant in the Zoological Institute.

Mr. and Mrs. Theodore Bent have started on another expedition to Southern Arabia, where they hope to continue the archæological and botanical work commenced last year in the Hadramaut Valley. They expect to return to England next April.

Mr. A. Trevor-Battye, about whose safety so unnecessary a fuss was made in October last, has returned from Kolguev Island, where he went about the end of June to study and collect the birds of the island.

We regret to learn that M. de Brazza, the well-known explorer, suffered shipwreck near Tchumber, on his way back from Kounde to Brazzaville on September 30. M. de Brazza was no worse for his experience, but all his papers were unfortunately lost.

A Life of Joseph Wolfe, the famous painter of animals, has just been completed by Mr. A. H. Palmer. Many examples of his work are in the possession of the Zoological Society, some of the most striking of which are those of the larger apes, and hang on the walls of the meeting room.

Mr. Spencer Moore, who, under somewhat unfavourable conditions, recently made a successful botanical exploration of a portion of the Matto Grosso district in Brazil, has gone to seek a better return for his labour in the gold-fields of West Australia. We trust he will make money enough for him to devote the rest of his life to botanical work.

SCIENCE at Oxford University will lose a friend in Professor Sir Henry W. Acland, who has stated that he will resign the Regius Professorship of Medicine at the close of the year. He has fought the cause of Science for many years at Oxford in the teeth of much opposition, and has carefully promoted and watched over the development of museums and educational matters in the University. But no doubt his withdrawal from the cares of office will not altogether deprive his colleagues of his valuable aid.

CAMBRIDGE University benefits under the will of the late Mr. Samuel Sandars to the extent of £2,000. The money is left for the endowment of a reader in Bibliography.

IN our third volume (p. 451) we published an account of the proposed Sedgwick Memorial Museum at Cambridge, by Mr. H. Woods. We regret to learn from the *Cambridge University Reporter* that "even on the lowest tender, the cost of the building would exceed by £4,500 the estimate which was before the Senate when the Grace approving the plan was passed." Since it is considered that the University cannot afford so large a sum, the Syndicate appointed to report on the matter have recommended that the plan be reconsidered, and if necessary a new one substituted for it.

AMONG the examiners for the Natural Science Tripos at Cambridge will be found Professor Lewis and H. A. Miers for Mineralogy; Philip Lake and Professor Cole for Geology; W. Bateson and Professor Hickson for Zoology; Professor Oliver and W. Gardiner for Botany, while for Human Anatomy Professor Macalister and Dr. Rolleston, and for Physiology W. B. Hardy and Professor Schäfer have been appointed.

FROM the Report of the Director of the Science and Art Museum, Dublin, we learn that the electric light will be extended to the Natural History Museum and various other buildings during the current year. We wish the same could be said of our London institution. One of the most valuable additions made to the collections last year was the collection of British Marine and Land Mollusca formed by Edward Waller. This collection contains a large number of the rarities belonging to Gwyn Jeffreys, whose own collection was unfortunately allowed to go to America. A small timber museum is being prepared, and arrangements are being made for the exhibition of illustrative sets of Irish plants from various localities. The Botanical laboratory is now in good going order, and original investigations on Irish Marine Algæ are in course of progress by Miss Hensman. The attendance of the public at the Museum is in excess of previous years, and the daily average was 1,000. With regard to Sunday attendance the average for the Museum was 979, and that for the Botanic Gardens 5,386. This is most encouraging. The Director insists on the importance of keeping up the library, the grants being insufficient for the purpose of the purchase of books necessary for the determination of the specimens. This is a want also keenly felt in our London institutions.

WE regret that the Raffles Museum at Singapore is still without a curator. It will be remembered that about a year ago, Dr. Haviland, who had come from the Sarawak Museum in Borneo, and who had done much to improve the condition of the Raffles Museum and to save money to its Committee, was compelled to resign on account of the insufficiency of his salary, only 200 dollars (£20 16s.) a month, which the Government refused to increase. This valuable museum has since then been in the charge of a clerk, at 150 dollars a month, nor is there any immediate prospect of a more competent individual being appointed. We regret the financial position of the Colony, but hope that it will not be thought necessary to extend this penny-wise policy to other of its scientific appointments.

On the completion of the decorations and renovation to which we have already referred, the Bristol Museum was re-opened by the municipal authorities on November 12. The hours are now extended from 10 a.m. to 9 p.m. daily. A Reference Library has been added. An extension of the Oldham Public Library and Museum has also been opened this month, in the form of a lecture-hall capable of seating 900 people. Free lectures are given each Saturday evening during the winter. The Art Gallery at Oldham is already famous among Lancashire institutions, and it is now proposed to devote attention to providing an adequate Natural History Collection.

The Royal Society Medals have been awarded as follows:—Professor Cleve, of Upsala, receives the Davy medal for his researches on the rare earths; Professor Huxley, the Darwin Medal; Professor Victor Horsley, one of the Royal Medals. No more appropriate award could be given to Professor Huxley, and we are glad to hear that Professor Horsley is to have a Royal Medal for researches so beneficial to mankind, though mankind is already sufficiently grateful to so distinguished a benefactor.

We learn from the *Birmingham Post* that the card catalogue in the library of the Royal College of Surgeons will be utilised, when finished, as copy for a new catalogue of the library. A printed catalogue of this rich medical library would be of great service, as many books dealing with general natural science are contained therein. The College has also acquired a ground plan of John Hunter's house in Leicester Square, drawn by William Clift, Hunter's pupil, which shows the arrangement, not only of his rooms, but much of their contents.

At the opening meeting of the Zoological Society, held on November 6, Professor Sir William Flower exhibited and read extracts from a letter and diaries from Emin Pasha. The letter recorded the dispatch of specimens for the British Museum, but was undated. The diary commenced on May 29, 1892, and was continued till October 12, 1892, when Emin was close to Stanley Falls. It consisted chiefly of notes on the birds he had collected on this his last journey. The collections have never been received in this country, and it is probable they were destroyed by the band that murdered the traveller. The manuscripts had been received by Sir William Flower from the agent of the Congo State at Brussels.

The Geologists' Association inaugurated their session on November 2 by an exhibition of lantern slides of photographs of places of geological interest, instead of holding the usual conversazione. The exhibition, which seemed to be of much interest to the members, was chiefly remarkable for some views taken in deep mines in Cornwall, by Mr. W. Thomas, and others of the Festiniog district, taken by Mr. J. C. Burrows. The views were confined to British subjects, and Messrs. Preston, Lardeur, and Hiddon showed excellent results taken during the various excursions of the Association.

At the next meeting of the Association, on December 7, Mr. A. Smith Woodward promises a note on the Megalosaurian teeth that have been discovered by Mr. J. Alstone in the Portlandian of Aylesbury, after which (the Honorary Secretary asks us to state) Professor McKenny Hughes, Mr. H. W. Monckton, and Dr. Frazer Hume will describe the geology of their recent tour in Switzerland.

From the *Journal* of the Oxford University Scientific Club, of which no. 18 has just reached us, we learn that Mr. M. D. Hill has been granted the use of the British Association Table at Naples, where he intends to continue his researches on artificial fertilisation. At a meeting of the Club on October 26, Mr. Garstang read a paper "On some modifications of the Tunicate pharynx induced by the violent ejection of water."

Despite the exertions of this energetic Club, we regret to observe that the study of geology still thrives so ill in this same University of Oxford. The examiners for

the Burdett-Coutts' Scholarship have once more had to report that no candidate of sufficient merit has presented himself.

The *Journal of the Marine Biological Association* (vol. iii., no. 3) contains the statements of receipts and expenditure for the year ending May 31, 1894, as well as the directors' report. The income for the past year was £2,172, including the annual grants of £1,000 from H.M. Treasury and £400 from the Fishmongers' Company. In connection with our Editorial note in the last number, it is interesting to read that the rent of tables produced only £36 16s. 3d. We are glad to hear that the trouble about bad sea-water supply has been detected and satisfactorily settled.

The *American Naturalist* states that the American Association for the Advancement of Science has again subscribed $100 for a table at the Marine Biological Laboratory at Woods Holl. Any member or applicant for membership of the Association may apply for the table through the permanent secretary, Professor F. W. Putnam, Cambridge, Mass. The award is made by a committee of five.

A "Botanical Society of America" has been founded in Brooklyn, N.Y., and Professor W. Trelease, of St. Louis, has been chosen first president.

The A.W.P.L. and P.N.E.U. bid fair to become as firmly established among us as the Y.M.C.A. and the M.A.B.Y.S. The A.W.P.L. however has, in consequence possibly of the rivalry of the Pioneer Club, changed its name to the "Women Lecturers' Association," and will no doubt be symbolised by W.L.A. Under the auspices of the W.L.A. a course of six lectures for children on "Our Animal Friends" is being delivered by Mrs. Rose (Certified Student, Royal College of Science, London). The time is 3 p.m. on Wednesdays, and the place is, as heretofore, one of the geological galleries in the Natural History Museum. Tables of strata and cases of rocks and fossil shells are so very appropriate to talks on the Cat, Dog, Horse, Rabbit, and Mouse. The kindness of the trustees also permits the Museum specimens to be drawn upon for the illustration of the lectures. Tickets for the course are 10s. Our representative informed us that the first two lectures were poorly attended We hope the rest will be more successful.

Meanwhile the Belgravia branch of the P.N.E.U. announces certain free lectures, one of which, on December 4, should at least attract those interested in natural science. It is "On the study of Natural History as a means to Moral and Mental Development," and will be delivered by Miss Shackleton, at 35 Cranley Gardens, S.W., at 4.30 p.m. The Secretary of the P.N.E.U. is Miss Jennie Paterson, 28 Victoria Street, S.W. The Secretary of the W.L.A. is Miss Edith Bradley, 4 Caroline Place, W.C.

A course of twenty-five lectures on the History of Geography and of Geographical Discovery, by Mr. H. J. Mackinder, is now in progress at Gresham College on Mondays at 6 p.m. These lectures are under the auspices of the Royal Geographical Society and the London University Extension.

The interesting series of Cantor Lectures, which were delivered by Mr. Hugh Stanners on "Artificial Foliage in Architecture," are now being printed in the *Journal of the Society of Arts*. The stem and the flower are dealt with in the *Journal* for November 2. They are accompanied by some good illustrations.

We learn from the *Pall Mall Gazette* that Mr. Hovey, in the course of a paper read before the American Forestry Society, stated that the remains of silicified trees in Arizona, known as the "Arizona fossil forest," are being ground into powder by a commercial company as a substitute for emery.

CORRESPONDENCE.

"ANLAGEN."

THE word "blast," proposed (NATURAL SCIENCE, v., p. 368) as an equivalent for the German "Anlage," has the certainly great merit of shortness, but has it not likewise some shocking demerits in the way of earlier associations? We are accustomed indeed to the blast of a bugle or a trumpet; but what is to be thought about "the blast of an organ"? I venture to suggest "primule" as an irreproachable term.

Salt Hill, Galway. W. E. HART.

THE MUSEUMS' ASSOCIATION.

As a member of the Museums' Association I read the note entitled "Science at a Picnic," in your August number, with much interest, not unmixed with astonishment at your boldness. Now that I have returned from a distant land where even NATURAL SCIENCE did not penetrate, I have read the replies from the Secretaries of the Association, and from a member of the Dublin Local Committee, to which your strictures not unnaturally gave rise. Now it would be affectation on my part to overlook the fact that I am the member of the Association alluded to by Messrs. Platnauer, Howarth, and Johnson, who appeared at the last moment with "some notes," "of an extremely discursive nature," "which he wished to descant upon," etc., etc. If this paper of mine—which certainly was discursive in that it dealt with fifteen museums in different parts of the world—is one of those to which you alluded as having been burked, I beg leave to state that you are in error. I had absolutely no *locus standi*. Not only did I send no intimation of my paper till after the programme was printed, but though I had received most courteous permission by telegraph to read the paper on the first day, I did not appear with it till the last day; and in spite of this I met with the utmost consideration at the hands of the officers of the Association, of various members of the local committee, and especially of Professor Johnson himself. I may also add that, although my paper is one of great length, it has been most cordially accepted for publication in the Report of the Association.

After saying this, I do not think I can possibly be misunderstood if I venture to express my agreement with your main thesis. Without referring to what was privately said by other unofficial members of the Association, I need only state that I, at least, was one of those who "could ill spare their time," and to whom, consequently, "the insertion of a day's excursion between the two days of meeting proved vexatious." This, indeed, was the very reason why I was unable to intimate my intention of attending the meeting; and after all I only managed to be present by travelling two nights in succession. It is perfectly possible, as Professor Johnson says, that discussion "was invited once or twice, and was not forthcoming." People who have the most to say are not likely to speak when the allotted time has already been exceeded. Silence is especially golden when the luncheon hour has struck and much business has yet to be got through. It would be invidious to mention special papers, and obviously one cannot give the names of members who undoubtedly would have spoken on them had time permitted. It is enough to contrast the statement of the Secretaries that "the volume of *Proceedings* of the Dublin Meeting will be the largest that has ever been published by the Association," with the other statement, also by the Secretaries, that only seven hours "were devoted to papers and discussions. F. A. BATHER.

[Our Comments on this subject were written with full knowledge of the circumstances attending Mr. Bather's oration. We did not count it among the papers of which the reading and discussion were unduly curtailed.—ED.]

I HOPE you will permit me a word in this discussion. As a member of the Association who was present throughout the Dublin meeting, although I personally feel extremely grateful to the able Secretaries and to the local committee, whose indefatigable exertions made the meeting the success it was, I must nevertheless express sympathy with the feeling which actuated your editorial note in NATURAL SCIENCE for August. The object of our Association is undoubtedly purely practical; that is, we meet mainly for the purpose of seeing and learning of new and efficient mechanical appliances and new methods, for the display and arrangement of the objects in Museums, considered entirely apart from the scientific or artistic details of the objects themselves. This we aim at accomplishing by the inspection of the Museums within reach of the place of meeting, by the reading of papers which describe the arrangements, actual or proposed, in these or other Museums, and by the discussion and explanation of the same. Now, on the last day of the meeting I did feel that the reading of papers and the discussion were considerably restricted owing to want of time; and one kept silence in regard to many points on which one would have liked more information, because this want was evident.

The excursion to Bray—which all those who joined in it described (so far as I heard) as charming (for I personally employed the day in re-visiting the Museums in Dublin, gathering details of the many excellent devices introduced there by Dr. Ball and his officers, some of which I am now trying to give effect to here)—was a part of the programme that some others besides myself felt might have been postponed, and the day given instead to the discussion of the many important appliances described, and other matters raised (but *scarcely* settled) in papers read before the Association. Lord Powerscourt's collection, though of the highest interest *per se*, did not pretend to any arrangement which could afford new hints to the *Museum Curator*. Such luxuries as this excursion and visits to other places of great interest in themselves, but only indirectly beneficial to us as *Curators*, might, on future occasions, I think, be advantageously deferred till the true work of the Association has been accomplished, when those who are able to remain would enjoy them with greater zest and a clear conscience.

The Museums, Liverpool. HENRY O. FORBES.

CHANGE OF ADDRESS.

In future the PUBLISHING AND EDITORIAL BUSINESS *of* "NATURAL SCIENCE" *will be carried on at the Offices of* MESSRS. RAIT, HENDERSON & CO., LTD., 22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C.

TO CONTRIBUTORS.—*All communications to be addressed to the* EDITOR *of* "NATURAL SCIENCE" *at the above address.*

TO SUBSCRIBERS.—"NATURAL SCIENCE" *will be delivered* POST FREE *to any address in the Postal Union, for an* ANNUAL SUBSCRIPTION *of* FOURTEEN SHILLINGS, *or its equivalent in foreign money, payable in advance to* MESSRS. RAIT, HENDERSON & CO., LTD., *at the above address.*

VOLUME VI. *will begin with the* JANUARY *number; but Subscriptions, as above, may begin at any time. Those who may have already renewed their subscriptions with Messrs. Macmillan will receive their copies as heretofore.*

SINGLE NUMBERS, *at a price of* ONE SHILLING NETT, *may be ordered of any* BOOKSELLER; *or will be delivered* POST FREE *by* MESSRS. RAIT, HENDERSON & CO., LTD., *on receipt of* ONE SHILLING AND TWOPENCE.

TO THE TRADE.—"NATURAL SCIENCE" *will be ready for delivery to the* TRADE *on the 25th of every month. Copies will be obtainable, by Sale or Exchange, and at the same rates as heretofore, from* MESSRS. RAIT, HENDERSON & CO., LTD., 22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C.

ALL RIGHTS RESERVED.

Vol. V. No. 29

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

JULY, 1894.

CONTENTS.

PAGE

Notes and Comments 1
Mathematical Biology — Another Critic of Weismann and Another Theory — Normal Nature of Ammonite Abnormalities — Echinoderms — Depths of the Sea—The Jungle Book—The Education of Sally—The Bird's Foot—Colours of Birds' Eggs — Tadpoles — Museums' Association — Sunday Opening of Museums—Darwin and the Y.M.C.A.

I. Some Shell-boring Algæ. By Professor T. Johnson, B.Sc., F.L.S. 17

II. An Address to the Museums' Association on the Museums of Dublin. By Professor Valentine Ball, C.B., F.R.S. 22

III. Recent Progress in our Knowledge of Earthworms and their Allies. By F. E. Beddard, M.A., F.R.S. 45

IV. Nearctic or Sonoran? By G. H. Carpenter, B.Sc. 53

Some New Books 58
Scientific Taxidermy. By R. W. Shufeldt—Creatures of other Days. By H. N. Hutchinson. (Illustrated.)—The Camel. By A. G. Leonard — Blind Crustacea. By Chas. Chilton — Gestaltung und Vererbung. By W. Haacke—Flore de France. By A. Acloque—Natural History of Plants. By K. von Marilaun—Index to Periodical Literature. By E. Hetherington—The Country Month by Month—New Serials.

Obituary 72
George John Romanes—A. von Klipstein—József von Szabó—K. A. Fiedler—Alphonse Derbès—Thomas Morong—K. F. Thedenius.

News of Universities, Museums, and Societies 75

Correspondence:—George Henslow—Entomophilos—Agnes Crane 79

LONDON AND NEW YORK: MACMILLAN & CO.

PRICE ONE SHILLING NETT.
In the United States, Thirty Cents.

Latest Publications
OF THE
Zoological Society of London.

Proceedings of the Zoological Society of London, 1894, Part I., containing the papers read at the Scientific Meetings held in January and February last, with 16 plates, price 12s.

To be obtained at the Society's Office:

3 HANOVER SQUARE, W.,

OR THROUGH ANY BOOKSELLER.

WRIGHT'S COAL TAR SOAP

PROTECTS FROM FEVERS MEASLES SMALL POX &c.
A LUXURY FOR THE BATH. INVALUABLE FOR THE NURSERY.
PROMOTES THE HEALTHY ACTION OF THE SKIN
THE ONLY TRUE ANTISEPTIC SOAP BRITISH MEDICAL JOURNAL
MOST EFFECTIVE IN SKIN DISEASES. LANCET
TABLETS 6d
SOLD EVERYWHERE.
RECOMMENDED BY THE MEDICAL FACULTY.
REFUSE ALL OTHER TAR SOAPS

Watkins & Doncaster,
Naturalists,
36 STRAND, LONDON, W.C.
(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application

MUSEUM SPECIMENS

OF all classes of Marine Animals a speciality. *Sponges, Annelids, Molluscs* and *Tunicates* well displayed in finest glass museum jars in clear fluid. Price 2s. 6d. to 10s. each. Average 4s.

Collections of dried *Echinoderms* and *Crustaceans* in large and small series.

British Fishes by the famous Davidson process of Taxidermy. (Gold medal, Paris, 1889.)

SPECIAL.—Skeleton of *Scyllium* in museum jar, 18 in. high. Price 25s.

Disarticulated Lobster, a splendid preparation—all parts lettered, with text. 22s.

MICROSCOPICAL PREPARATIONS AND DISSECTING SPECIMENS.

Lists on Application.

SINEL & HORNELL, BIOLOGICAL STATION, JERSEY.

BREAKFAST—SUPPER.

EPPS'S

GRATEFUL-COMFORTING

COCOA

BOILING WATER OR MILK.

ALL APPLICATIONS FOR ADVERTISEMENT SPACE IN THIS JOURNAL SHOULD BE SENT TO

John Haddon & Co.,

BOUVERIE HOUSE,
SALISBURY SQUARE, LONDON, E.C

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.		(To all places Abroad) £ s. d.
Yearly	1 8 0	Yearly	1 10 6
Half-Yearly	0 14 6	Half-Yearly	0 15 6
Quarterly	0 7 6	Quarterly	0 8 0

Money Orders to be made payable to MACMILLAN & CO. Office: 29 Bedford Street, Strand, London.

"WESTMINSTER REVIEW" FOR JUNE, 1894.

CONTENTS.

PUBLISHED MONTHLY, PRICE 2s. 6d.

I. **The Miners' Eight Hour Queston.** By WALTER T. THOMSON.
II. **William III.**
III. **The Nationality Movement of the Nineteenth Century.** By J. DOWNIE.
IV. **The Story of an African Farm: A Reflection.** By T. F. HUSBAND, M.A.
V. **Social Democracy and Liberty.** By F. B. FISHER.
VI. **Prosperity and Prices.** By CECIL B. PHIPSON.
VII. **Science in Song.** By THOMAS E. MAYNE.
VIII. **Apprentice Life at Sea.** By JOHN G. ROWE.
IX. **The Revolt of the Daughters: An Answer by One of Them.** By GERTRUDE HEMERY.
X. **In Praise of Perfect Music: Nocturn.** By R. THIRLMERE.
XI. **Superstitions of the Opal.** By LAURA B. STARR.
XII. **Contemporary Literature.**
    1. **Philosophy and Theology.**
    2. **Sociology, Politics, Voyages, and Travels.**
    3. **History and Biography.**
    4. **Belles Lettres.**
    5. **Poetry.**
    6. **The Drama.**

London: **HENRY & COMPANY**, 6 Bouverie Street, E.C.

IN 8vo, CLOTH, PRICE 14s.

NEURALGIA AND KINDRED DISEASES OF THE NERVOUS SYSTEM.

(THEIR NATURE, CAUSES, AND TREATMENT; ALSO A SERIES OF CASES, PRECEDED BY AN ANALYTICAL EXPOSITION OF THEM.)

By JOHN CHAPMAN, M.D., M.R.C.P., M.R.C.S.

From the "Medical Times and Gazette," June 14, 1873.

"Dr. Chapman speaks not as a mere theorist. He publishes in adequate detail a very large number of important cases, which together make up a large mass of evidence in favour of his views—evidence which cannot be disregarded. . . . These numerous examples of positive success cannot be without great weight: many of them, indeed, are very striking. We do not shrink from saying that these cases are really very striking, for Dr. Chapman relates them in cautious and temperate language. . . . He has written a very able book, based on observations and arguments which have evidently cost him much labour and time. We consider that in this book he makes a very strong claim upon the attention of his professional brethren, who are now bound to prove or disprove his allegations; we have, therefore, given the subject the space and the serious attention in our columns which so large and temperate a work fairly demands. We cannot now do more; but *it is evident that if Dr. Chapman establishes any great part of his thesis, he has made one of the most remarkable therapeutic discoveries in the history of the art.*"

From the "Medical Press and Circular," April 30, 1873.

"The work before us, from the pen of Dr. Chapman, presents an elaborate analysis of the symptoms of the whole group of neuralgic diseases, and an interpretation of those symptoms according to the theories of neuro-pathology to which the author has been led by observation of the effects of the particular system of treatment in connection with which his name is chiefly known to the Medical profession. The careful study of the natural history of the disease, and of the complications which it presents, evinces both careful and continued observation, and a thorough acquaintance with the literature of the subject."

London: J. & A. CHURCHILL.

GEOLOGISTS' ASSOCIATION.

Meetings are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 King's Road, Chelsea.

The FEBRUARY No. of the PROCEEDINGS, Price 1s. 6d., is now ready.

IT CONTAINS PAPERS ON

BRITISH CRETACEOUS SHARKS' TEETH, by A. SMITH WOODWARD,

AND ON

A NEW FOSSILIFEROUS HORIZON IN THE ISLE OF WIGHT, by THOS. LEIGHTON.

The MAY No. will shortly be ready,

CONTAINING PAPERS ON

GEOLOGY IN THE FIELD AND IN THE STUDY, by H. B. WOODWARD,

AND ON THE

GENESIS OF THE CHALK, by W. F. HUME.

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands.

Vol I. (1892), Price 3s. 6d. Vol. II. (1893), Price 5s. Vol. III. (1894) will be sent in monthly parts to any address for 5s.

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, A. G. More, Rev. W. F. Johnson, R. J. Ussher, R. Warren, Dr. V. Ball, Prof. W. J. Sollas, Prof A. C. Haddon, Rev. H. Friend, W. F. de V. Kane.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

TELEGRAPHIC ADDRESS: "ADVERTENCE, LONDON."

TELEPHONE No. 2,895.

Rait, Henderson & Co., LIMITED.

Artistic Letterpress - - - - and Lithographic

PRINTERS.

SPECIALISTS FOR

BOOK, MAGAZINE & CATALOGUE PRINTING.

ESTIMATES GIVEN PROMPTLY FOR THE FINEST WORK AT REASONABLE PRICES.

"NATURAL SCIENCE" is a Specimen of our Printing.

Also Printers of "ANNALS OF BRITISH GEOLOGY," by Professor BLAKE, M.A. &c., &c.

OFFICE AND WORKS:

22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C.

PRINTED FOR THE PROPRIETORS BY RAIT, HENDERSON & CO., LIMITED, 22 ST. ANDREW STREET, LONDON, E.C.

ALL RIGHTS RESERVED.

Vol. V. No. 30

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

AUGUST, 1894.

CONTENTS.

		PAGE
	SPECIAL ILLUSTRATED SUPPLEMENT—TAXIDERMY AS A FINE ART	
	Notes and Comments	81
	Vox Populi—The British Association—The Marine Biological Association—Natural History as a Recreation for Sailors—The Worm, the Gastropod, the Coral and the Bivalve—Science at a Picnic—The Life of a Museum—Winchester Once More—Science and Nature—Science and Art—In Old Japan—The Hongkong Plague—Sewer Air—Science and Literature—Food for Babes—The Attack on the Pole—The Pollination of the Yucca.	
I.	**The Evolution of the Thames. By J. Walter Gregory, D.Sc., F.G.S. (Illustrated)**	97
II.	**Some Account of the Gall-making Insects of Australia. By Walter W. Froggatt**	109
III.	**Books of Reference in the Natural Sciences. By C. Davies Sherborn, F.G.S., F.Z.S.**	115
IV.	**Some Reforms in the Oxford University Museum. By E. S. Goodrich. (With Plates I.—III.)**	128
V.	**Hertwig's "Preformation or New Formation." By P. Chalmers Mitchell, M.A., F.Z.S.**	132
	Some New Books	135
	A Handbook of the Marsupialia and Monotremata. By R. Lydekker—A Handbook of the Birds of Great Britain. By R. Bowdler Sharpe—Comparative Oology of North American Birds. By R. W. Shufeldt—Linnæus's "System of Nature." Reprint of Tenth Edition—Ueber das Verhaeltniss des Geschlechts in der Natur. By Dr. Georg Klebs—Biological Lectures. By A. Milnes Marshall—Introduction to the Study of the Brachiopoda. By James Hall—Lehrbuch der Zoologie. By Dr. J. E. V. Boas—Geology. By Charles Bird—The Jurassic Rocks of Britain. By H. B. Woodward—British Museum Catalogue of Wealden Plants. By A. C. Seward—The Climatology of Maryland—Congrès Géologique International, 1891	
	Obituary	151
	Brian Houghton Hodgson—Carl Joseph Hyrtl—F. Heine—L. F. Lethierry—E. Norton—F. Quiroga y Rodriquez—C. T. Liebe E. Lefévre.	
	News of Universities, Museums, and Societies	155
	Correspondence:—J. Lawrence-Hamilton—Edward Crane—Frank Finn	159

LONDON AND NEW YORK: MACMILLAN & CO.

PRICE ONE SHILLING NETT.
In the United States, Thirty Cents.

Latest Publications
OF THE
Zoological Society of London.

Proceedings of the Zoological Society of London, 1894, Part I., containing the papers read at the Scientific Meetings held in January and February last, with 16 plates, price 12s.

To be obtained at the Society's Office:

3 HANOVER SQUARE, W.,

OR THROUGH ANY BOOKSELLER.

WRIGHT'S COAL TAR SOAP

PROTECTS FROM FEVERS MEASLES SMALL POX &c.
A LUXURY FOR THE BATH, INVALUABLE FOR THE NURSERY
PROMOTES THE HEALTHY ACTION OF THE SKIN
THE ONLY TRUE ANTISEPTIC SOAP BRITISH MEDICAL JOURNAL
MOST EFFECTIVE IN SKIN DISEASES. LANCET
TABLETS 6d/-
SOLD EVERYWHERE.
RECOMMENDED BY THE MEDICAL FACULTY.
REFUSE ALL OTHER TAR SOAPS

Watkins & Doncaster,
Naturalists,
36 STRAND, LONDON, W.C.
(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application

MUSEUM SPECIMENS

OF all classes of Marine Animals a speciality. *Sponges, Annelids, Molluscs* and *Tunicates* well displayed in finest glass museum jars in clear fluid. Price 2s. 6d. to 10s each. Average 4s.

Collections of dried *Echinoderms* and *Crustaceans* in large and small series.

British Fishes by the famous Davidson process of Taxidermy. (Gold medal, Paris, 1889.)

SPECIAL.—Skeleton of *Scyllium* in museum Jar, 18 in. high. Price 25s.

Disarticulated Lobster, a splendid preparation—all parts lettered, with text. 22s.

MICROSCOPICAL PREPARATIONS AND DISSECTING SPECIMENS.

Lists on Application.

SINEL & HORNELL, BIOLOGICAL STATION, JERSEY.

BREAKFAST—SUPPER.

EPPS'S

GRATEFUL-COMFORTING

COCOA

BOILING WATER OR MILK.

ALL APPLICATIONS FOR ADVERTISEMENT SPACE IN THIS JOURNAL SHOULD BE SENT TO

John Haddon & Co.,

BOUVERIE HOUSE,
SALISBURY SQUARE, LONDON, E.C.

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.		(*To all places Abroad*) £ s. d.
Yearly	1 8 0	**Yearly**	1 10 6
Half-Yearly	0 14 6	**Half-Yearly**	0 15 6
Quarterly	0 7 6	**Quarterly**	0 8 0

Money Orders to be made payable to MACMILLAN & CO. Office: 29 Bedford Street, Strand, London.

"WESTMINSTER REVIEW" FOR JUNE, 1894.

CONTENTS.

PUBLISHED MONTHLY, PRICE 2s. 6d.

I. **The Miners' Eight Hour Question** By WALTER T. THOMSON.
II. **William III.**
III. **The Nationality Movement of the Nineteenth Century.** By J. DOWNIE.
IV. **The Story of an African Farm: A Reflection.** By T. F. HUSBAND, M.A.
V. **Social Democracy and Liberty.** By F. B. FISHER.
VI. **Prosperity and Prices.** By CECIL B. PHIPSON.
VII. **Science in Song.** By THOMAS E. MAYNE.
VIII. **Apprentice Life at Sea.** By JOHN G. ROWE.
IX. **The Revolt of the Daughters: An Answer by One of Them.** By GERTRUDE HEMERY.
X. **In Praise of Perfect Music: Nocturn.** By R. THIRLMERE.
XI. **Superstitions of the Opal.** By LAURA B. STARR.
XII. **Contemporary Literature.**
1. **Philosophy and Theology.**
2. **Sociology, Politics, Voyages, and Travels.**
3. **History and Biography.**
4. **Belles Lettres.**
5. **Poetry.**
6. **The Drama.**

London: **HENRY & COMPANY**, 6 Bouverie Street, E.C.

IN 8vo, CLOTH, PRICE 14s.

NEURALGIA AND KINDRED DISEASES OF THE NERVOUS SYSTEM.

(THEIR NATURE, CAUSES, AND TREATMENT; ALSO A SERIES OF CASES, PRECEDED BY AN ANALYTICAL EXPOSITION OF THEM.)

By JOHN CHAPMAN, M.D., M.R.C.P., M.R.C.S.

From the "Medical Times and Gazette," June 14, 1873.

"Dr. Chapman speaks not as a mere theorist. He publishes in adequate detail a very large number of important cases, which together make up a large mass of evidence in favour of his views—evidence which cannot be disregarded. . . . These numerous examples of positive success cannot be without great weight: many of them, indeed, are very striking. We do not shrink from saying that these cases are really very striking, for Dr. Chapman relates them in cautious and temperate language. . . . He has written a very able book, based on observations and arguments which have evidently cost him much labour and time. We consider that in this book he makes a very strong claim upon the attention of his professional brethren, who are now bound to prove or disprove his allegations; we have, therefore, given the subject the space and the serious attention in our columns which so large and temperate a work fairly demands. We cannot now do more; but *it is evident that if Dr. Chapman establishes any great part of his thesis, he has made one of the most remarkable therapeutic discoveries in the history of the art.*"

From the "Medical Press and Circular," April 30, 1873.

"The work before us, from the pen of Dr. Chapman, presents an elaborate analysis of the symptoms of the whole group of neuralgic diseases, and an interpretation of those symptoms according to the theories of neuro-pathology to which the author has been led by observation of the effects of the particular system of treatment in connection with which his name is chiefly known to the Medical profession. The careful study of the natural history of the disease, and of the complications which it presents, evinces both careful and continued observation, and a thorough acquaintance with the literature of the subject."

London: J. & A. CHURCHILL.

GEOLOGISTS' ASSOCIATION.

Meetings are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 King's Road, Chelsea.

The FEBRUARY No. of the PROCEEDINGS, Price 1s. 6d., is now ready.

IT CONTAINS PAPERS ON

BRITISH CRETACEOUS SHARKS' TEETH, by A. SMITH WOODWARD,

AND ON

A NEW FOSSILIFEROUS HORIZON IN THE ISLE OF WIGHT, by THOS. LEIGHTON.

The MAY No. will shortly be ready,

CONTAINING PAPERS ON

GEOLOGY IN THE FIELD AND IN THE STUDY, by H. B. WOODWARD,

AND ON THE

GENESIS OF THE CHALK, by W. F. HUME.

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands.

Vol I. (1892), Price 3s. 6d. Vol. II. (1893), Price 5s. Vol. III. (1894) will be sent in monthly parts to any address for 5s.

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, A. G. More, Rev. W. F. Johnson, R. J. Ussher, R. Warren, Dr. V. Ball, Prof. W. J. Sollas, Prof A. C. Haddon, Rev. H. Friend, W. F. de V. Kane.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

TELEGRAPHIC ADDRESS: "ADVERTENCE, LONDON."

TELEPHONE No. 2,895.

Rait, Henderson & Co.,

LIMITED,

Artistic Letterpress - - - - and Lithographic

PRINTERS.

SPECIALISTS FOR

BOOK, MAGAZINE & CATALOGUE PRINTING.

ESTIMATES GIVEN PROMPTLY FOR THE FINEST WORK AT REASONABLE PRICES.

"NATURAL SCIENCE" is a Specimen of our Printing.

Also Printers of "ANNALS OF BRITISH GEOLOGY," by Professor BLAKE, M.A. &c., &c.

OFFICE AND WORKS:

22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C.

PRINTED FOR THE PROPRIETORS BY RAIT, HENDERSON & CO., LIMITED, 22 ST. ANDREW STREET, LONDON, E.C.

ALL RIGHTS RESERVED.

Vol. V. No. 31

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

SEPTEMBER, 1894.

CONTENTS.

PAGE

Notes and Comments 161
Organic Life on Mars—Lord Salisbury's Address—An Untrue Tale—Lord Salisbury's North Poles of Science—Lord Salisbury on Natural Selection—Dwarfing by Experiment—A Moving Grove—Nematodes in the Blood of Man—Nematodes and Hop-Disease in Kent—The Indian Geological Survey—Tertiary Rivers—Landscape Marble—The Systematic Position of Trilobites—Species-Making and Species-Taking.

I. The Rev. George Henslow on Natural Selection. By Alfred Russel Wallace, LL.D. 177

II. Hertwig's "Preformation or New Formation." By P. Chalmers Mitchell, M.A., F.Z.S. 184

III. The Parasites of Malarial Fevers. By J. Walter Gregory, D.Sc., F.G.S. (Illustrated) 195

IV. A British Palm. By A. B. Rendle, M.A., F.L.S. 202

V. The Bird's Foot. 1. By F. A. Lucas. 2. By Frank Finn. 3. By P. Chalmers Mitchell. 208

VI. Notes from the British Association, 1894 214

Some New Books 226
The Internal Work of the Wind. By S. P. Langley—Survey of a Natural System of Plants. By E. Pfitzer—The Inheritance of Acquired Characters. By A. S. Packard—Agricultural Zoology. By J. Ritzema Bos. Translated by J. R. A. Davis—The "Monist" for July.

Obituary 234
George Huntington Williams—Dutreil de Rhins.

News of Universities, Museums, and Societies 235

Correspondence:—F. A. Bather—Jno. E. Hardman and E. P. Greenhalgh—John C. Willis—Gallio—C. H. B. Woodd .. 239

LONDON AND NEW YORK: MACMILLAN & CO.

PRICE ONE SHILLING NETT.

In the United States, Thirty Cents.

Latest Publications
OF THE
Zoological Society of London.

Proceedings of the Zoological Society of London, 1894, Part I:, containing the papers read at the Scientific Meetings held in January and February last, with 16 plates, price 12s.

To be obtained at the Society's Office:

3 HANOVER SQUARE, W.,

OR THROUGH ANY BOOKSELLER.

WRIGHT'S COAL TAR SOAP

PROTECTS FROM FEVERS MEASLES SMALL POX &c.
A LUXURY FOR THE BATH. INVALUABLE FOR THE NURSERY
PROMOTES THE HEALTHY ACTION OF THE SKIN
THE ONLY TRUE ANTISEPTIC SOAP BRITISH MEDICAL JOURNAL
MOST EFFECTIVE IN SKIN DISEASES. LANCET
TABLETS 6d/- SOLD EVERYWHERE.
RECOMMENDED BY THE MEDICAL FACULTY.
REFUSE ALL OTHER TAR SOAPS

Watkins & Doncaster,
Naturalists,
36 STRAND, LONDON, W.C.
(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application

MUSEUM SPECIMENS

OF all classes of Marine Animals a speciality.

Sponges, Annelids, Molluscs and *Tunicates* well displayed in finest glass museum jars in clear fluid. Price 2s. 6d. to 10s. each. Average 4s.

Collections of dried *Echinoderms* and *Crustaceans* in large and small series.

British Fishes by the famous Davidson process of Taxidermy. (Gold medal, Paris, 1889.)

SPECIAL.—Skeleton of *Scyllium* in museum Jar, 18 in. high. Price 25s.

Disarticulated Lobster, a splendid preparation—all parts lettered, with text. 22s.

MICROSCOPICAL PREPARATIONS AND DISSECTING SPECIMENS.

Lists on Application.

SINEL & HORNELL, BIOLOGICAL STATION, JERSEY.

BREAKFAST—SUPPER.

EPPS'S

GRATEFUL-COMFORTING

COCOA

BOILING WATER OR MILK.

ALL APPLICATIONS FOR ADVERTISEMENT SPACE IN THIS JOURNAL SHOULD BE SENT TO

John Haddon & Co.,

BOUVERIE HOUSE,
SALISBURY SQUARE, LONDON, E.C.

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£	s.	d.	(To all places Abroad)	£	s.	d.
Yearly	1	8	0	Yearly	1	10	0
Half-Yearly	0	14	6	Half-Yearly	0	15	0
Quarterly	0	7	6	Quarterly	0	8	0

Money Orders to be made payable to MACMILLAN & CO. Office: 29 Bedford Street, Strand, London.

"WESTMINSTER REVIEW" FOR JUNE, 1894.

CONTENTS.

PUBLISHED MONTHLY, PRICE 2s. 6d.

I. **The Miners' Eight Hour Question** By WALTER T. THOMSON.
II. **William III.**
III. **The Nationality Movement of the Nineteenth Century.** By J. DOWNIE.
IV. **The Story of an African Farm: A Reflection.** By T. F. HUSBAND, M.A.
V. **Social Democracy and Liberty.** By F. B. FISHER.
VI. **Prosperity and Prices.** By CECIL B. PHIPSON.
VII. **Science in Song.** By THOMAS E. MAYNE.
VIII. **Apprentice Life at Sea.** By JOHN G. ROWE.
IX. **The Revolt of the Daughters: An Answer by One of Them.** By GERTRUDE HEMERY.
X. **In Praise of Perfect Music: Nocturn.** By R. THIRLMERE.
XI. **Superstitions of the Opal.** By LAURA B. STARR.
XII. **Contemporary Literature.**
    1. **Philosophy and Theology.**
    2. **Sociology, Politics, Voyages, and Travels.**
    3. **History and Biography.**
    4. **Belles Lettres.**
    5. **Poetry.**
    6. **The Drama.**

London: HENRY & COMPANY, 6 Bouverie Street, E.C.

IN 8vo, CLOTH, PRICE 14s.

NEURALGIA AND KINDRED DISEASES OF THE NERVOUS SYSTEM.

(THEIR NATURE, CAUSES, AND TREATMENT; ALSO A SERIES OF CASES, PRECEDED BY AN ANALYTICAL EXPOSITION OF THEM.)

By JOHN CHAPMAN, M.D., M.R.C.P., M.R.C.S.

From the "Medical Times and Gazette," June 14, 1873.

"Dr. Chapman speaks not as a mere theorist. He publishes in adequate detail a very large number of important cases, which together make up a large mass of evidence in favour of his views—evidence which cannot be disregarded. . . . These numerous examples of positive success cannot be without great weight: many of them, indeed, are very striking. We do not shrink from saying that these cases are really very striking, for Dr. Chapman relates them in cautious and temperate language. . . . He has written a very able book, based on observations and arguments which have evidently cost him much labour and time. We consider that in this book he makes a very strong claim upon the attention of his professional brethren, who are now bound to prove or disprove his allegations; we have, therefore, given the subject the space and the serious attention in our columns which so large and temperate a work fairly demands. We cannot now do more; but *it is evident that if Dr. Chapman establishes any great part of his thesis, he has made one of the most remarkable therapeutic discoveries in the history of the art.*"

From the "Medical Press and Circular," April 30, 1873.

"The work before us, from the pen of Dr. Chapman, presents an elaborate analysis of the symptoms of the whole group of neuralgic diseases, and an interpretation of those symptoms according to the theories of neuro-pathology to which the author has been led by observation of the effects of the particular system of treatment in connection with which his name is chiefly known to the Medical profession. The careful study of the natural history of the disease, and of the complications which it presents, evinces both careful and continued observation, and a thorough acquaintance with the literature of the subject."

London: J. & A. CHURCHILL.

GEOLOGISTS' ASSOCIATION.

Meetings are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 King's Road, Chelsea.

The FEBRUARY No. of the PROCEEDINGS, Price 1s. 6d. *contains papers on*
BRITISH CRETACEOUS SHARKS' TEETH, by A. SMITH WOODWARD,
AND ON
A NEW FOSSILIFEROUS HORIZON IN THE ISLE OF WIGHT, by THOS. LEIGHTON.

The MAY No. *contains papers on*
GEOLOGY IN THE FIELD AND IN THE STUDY, by H. B. WOODWARD,
AND ON THE
GENESIS OF THE CHALK, by W. F. HUME.

The AUGUST No. contains a paper by Professor Lapworth and W. W. Watts on the GEOLOGY OF SOUTH SHROPSHIRE; and other papers.

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed
THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands.

Vol I. (1892), Price 3s. 6d. Vol. II. (1893), Price 5s. Vol. III. (1894) will be sent in monthly parts to any address for 5s.

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, A. G. More, Rev. W. F. Johnson, R. J. Ussher, R. Warren, Dr. V. Ball, Prof. W. J. Sollas, Prof A. C. Haddon, Rev. H. Friend, W. F. de V. Kane.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

TELEGRAPHIC ADDRESS:
"ADVERTENCE, LONDON."

TELEPHONE No. 2,895.

Rait, Henderson & Co.,

LIMITED.

Artistic Letterpress - - - - and Lithographic

PRINTERS.

SPECIALISTS FOR

BOOK, MAGAZINE & CATALOGUE PRINTING.

ESTIMATES GIVEN PROMPTLY FOR THE FINEST WORK AT REASONABLE PRICES.

"NATURAL SCIENCE" is a Specimen of our Printing.

Also Printers of "ANNALS OF BRITISH GEOLOGY," by Professor BLAKE, M.A. &c., &c.

OFFICE AND WORKS:

22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C.

PRINTED FOR THE PROPRIETORS BY RAIT, HENDERSON & CO., LIMITED, 22 ST. ANDREW STREET, LONDON, E.C.

ALL RIGHTS RESERVED.

Vol. V. No. 32

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

OCTOBER, 1894.

CONTENTS.

		PAGE
	Notes and Comments..	241
	Protozoa from pre-Cambrian Rocks—Primæval Life—The Primæval Lampreys Again—The Armoured Fore-runners of the Chordata—The Ancestry of the Chordata—The Ancestry of Modern Mammalia—European Pleistocene Mammalia—Pleistocene Mammalia from the Thames—Acclimatised Rats and Cats—Living Specimens of Protopterus—The Plague Bacillus—Small-pox.	
I.	The Origin of Species without the Aid of Natural Selection: A Reply. By Rev. George Henslow, M.A., F.L.S.	257
II.	Horticultural "Sports." By Charles T. Druery, F.L.S.	265
III.	On the Geology of the Plateau Implements of Kent. By Professor T. Rupert Jones, F.G.S. (Illustrated)	269
IV.	The Effect of Temperature on the Distribution of Marine Animals. By Otto Maas, Ph.D.	276
V.	On the Dispersal of the Nutlets in certain Labiates. By Miss Dorothea F. M. Pertz. (Illustrated)	284
VI.	Hertwig's "Preformation or New Formation." By P. Chalmers Mitchell, M.A., F.Z.S.	292
	Some New Books	298
	Elements of Palæontology. By F. Bernard.—The Physical Geology and Geography of Great Britain. By Sir A. C. Ramsay (ed. 6, by H. B. Woodward)—The Royal Natural History. By R. Lydekker—Studies on Docoglossa, &c. By B. Haller—The Salmon of the Elbe. By A. Fritsch—Ponds and Rock Pools. By H. Scherren—A History of the World. By E. Guyard—Experimental Plant Physiology. By W. Oels—Carboniferous Insects of Commentry. By C. Brongniart.	
	Obituary	313
	F. C. Maillot—W. M. Hind—E. A. Inglefield—P. L. Jouy—E. Haase—A. Hannover—M. Lessona—L. de Coulon—H. von Helmholtz.	
	News of Universities, Museums, and Societies	315
	Correspondence:—W. J. Lewis Abbott—H. M. Platnauer and E. Howarth—J. M. Clarke—F. A. Lucas.	318

LONDON AND NEW YORK: MACMILLAN & CO.

PRICE ONE SHILLING NETT.
In the United States, Thirty Cents.

Latest Publications
OF THE
Zoological Society of London.

Proceedings of the Zoological Society of London, 1894, Part I., containing the papers read at the Scientific Meetings held in January and February last, with 16 plates, price 12s.

To be obtained at the Society's Office:

3 HANOVER SQUARE, W.,

OR THROUGH ANY BOOKSELLER.

WRIGHT'S COAL TAR SOAP

PROTECTS FROM FEVERS MEASLES SMALL POX &c.
A LUXURY FOR THE BATH
INVALUABLE FOR THE NURSERY
REFUSE ALL OTHER TAR SOAPS
PROMOTES THE HEALTHY ACTION OF THE SKIN
THE ONLY TRUE ANTISEPTIC SOAP BRITISH MEDICAL JOURNAL
MOST EFFECTIVE IN SKIN DISEASES. LANCET
TABLETS 6d/-
SOLD EVERYWHERE.
RECOMMENDED BY THE MEDICAL FACULTY.

Watkins & Doncaster,
Naturalists,
36 STRAND, LONDON, W.C.
(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application

MUSEUM SPECIMENS

OF all classes of Marine Animals a speciality. *Sponges, Annelids, Molluscs* and *Tunicates* well displayed in finest glass museum jars in clear fluid. Price 2s. 6d. to 10s each. Average 4s.

Collections of dried *Echinoderms* and *Crustaceans* in large and small series.

British Fishes by the famous Davidson process of Taxidermy. (Gold medal, Paris, 1889.)

SPECIAL.—Skeleton of *Scyllium* in museum jar, 18 in. high. Price 25s.

Disarticulated Lobster, a splendid preparation—all parts lettered, with text. 22s.

MICROSCOPICAL PREPARATIONS AND DISSECTING SPECIMENS.

Lists on Application.

SINEL & HORNELL, BIOLOGICAL STATION, JERSEY.

BREAKFAST—SUPPER.

EPPS'S

GRATEFUL-COMFORTING

COCOA

BOILING WATER OR MILK.

ALL APPLICATIONS FOR ADVERTISEMENT SPACE IN THIS JOURNAL SHOULD BE SENT TO

John Haddon & Co.,

BOUVERIE HOUSE,
SALISBURY SQUARE, LONDON, E.C.

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.	(To all places Abroad)	£ s. d.
Yearly	1 8 0	Yearly	1 10 6
Half-Yearly	0 14 6	Half-Yearly	0 15 6
Quarterly	0 7 6	Quarterly	0 8 0

Money Orders to be made payable to MACMILLAN & CO. Office: 29 Bedford Street, Strand, London.

MESSRS. MACMILLAN & CO.'S

BOOKS FOR

STUDENTS OF EVOLUTION.

SOCIAL EVOLUTION. By BENJAMIN KIDD. Sixth Thousand. 8vo. 10s net.

EVOLUTION AND MAN'S PLACE IN NATURE. By HENRY CALDERWOOD, LL.D., Professor of Moral Philosophy, University of Edinburgh. Crown 8vo. 7s. 6d.

MATERIALS FOR THE STUDY OF VARIATION. Treated with Especial Regard to Discontinuity in the Origin of Species. By WILLIAM BATESON, M.A., Fellow of St. John's College, Cambridge. 8vo. 21s. net.

A THEORY OF DEVELOPMENT AND HEREDITY. By HENRY B. ORR, Ph.D., Professor at the Tulane University of Louisiana. Crown 8vo. 6s. net.

ORGANIC EVOLUTION AS THE RESULT OF THE INHERITANCE OF ACQUIRED CHARACTERS ACCORDING TO THE LAWS OF ORGANIC GROWTH. By DR. G. H. THEODOR EIMER, Professor of Zoology and Comparative Anatomy in Tübingen. Translated by J. T. CUNNINGHAM, M.A., F.R.S.E., late Fellow of University College, Oxford. 8vo. 12s. 6d.

THE SCIENTIFIC EVIDENCES OF ORGANIC EVOLUTION. By GEORGE J. ROMANES, M.A., LL.D., F.R.S. Crown 8vo. 2s. 6d. [*Nature Series.*

ARE THE EFFECTS OF USE AND DISUSE INHERITED? An Examination of the View held by Spencer and Darwin. By WM. P. BALL. Crown 8vo. 3s. 6d. [*Nature Series.*

EXPERIMENTAL EVOLUTION. Lectures delivered in the "Summer School of Science and Art," in Edinburgh, August, 1891. By HENRY DE VARIGNY, D.Sc., Assistant in the Museum d'Histoire Naturelle, Member of the Société de Biologie. Crown 8vo. 5s. [*Nature Series.*

THE COLOURS OF FLOWERS as Illustrated in the British Flora. By GRANT ALLEN. With Illustrations. Crown 8vo. 3s. 6d. [*Nature Series.*

By SIR JOHN LUBBOCK, F.R.S.

FLOWERS, FRUITS, AND LEAVES. Illustrated. 4s. 6d. [*Nature Series.*

ON BRITISH WILD FLOWERS, considered in Relation to Insects. Illustrated. 4s. 6d. [*Nature Series.*

THE ORIGIN AND METAMORPHOSES OF INSECTS. With Illustrations. 3s. 6d. [*Nature Series.*

By A. R. WALLACE, F.R.S.

DARWINISM: An Exposition of the Theory of Natural Selection, with Some of its Applications. With Maps and Illustrations. Extra Crown 8vo. 9s.

NATURAL SELECTION AND TROPICAL NATURE. Essays on Descriptive and Theoretical Biology. Extra Crown 8vo. 6s.

By T. H. HUXLEY, F.R.S.

METHOD AND RESULTS. Globe 8vo. 5s.

DARWINIANA. Globe 8vo. 5s.

MAN'S PLACE IN NATURE; and other Anthropological Essays. Globe 8vo. 5s.

MACMILLAN & CO., LONDON.

GEOLOGISTS' ASSOCIATION.

Meetings are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 King's Road, Chelsea.

The MAY No. *contains papers on*
GEOLOGY IN THE FIELD AND IN THE STUDY, by H. B. WOODWARD,
AND ON THE
GENESIS OF THE CHALK, by W. F. HUME.

The AUGUST No., Price 1s. 6d., *is now ready, containing papers on the*
GEOLOGY OF SOUTH SHROPSHIRE, by PROFESSOR LAPWORTH & W. W. WATTS;
(With two Plates and numerous Illustrations)
On CHALK IN HUNTINGDONSHIRE, by A. C. G. CAMERON;
AND ON
THE HYTHE BEDS OF THE LIPHOOK AND HINDHEAD DISTRICT, by B. FOWLER.

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed
THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands.

Vol I. (1892), Price 3s. 6d. Vol. II. (1893), Price 5s. Vol. III. (1894) will be sent in monthly parts to any address for 5s.

Among the contributors are Prof. G. A. J. Cole Prof. T. Johnson, Dr. R. F. Scharff, A. G. More, Rev. W. F. Johnson, R. J. Ussher, R Warren, Dr. V. Ball, Prof. W. J. Sollas, Prof A. C. Haddon, Rev. H. Friend, W. F. de V. Kane.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

TELEGRAPHIC ADDRESS:
"ADVERTENCE, LONDON."

TELEPHONE No. 2,895.

Rait, Henderson & Co.,

LIMITED.

Artistic Letterpress - -
- - and Lithographic

PRINTERS.

SPECIALISTS FOR

BOOK, MAGAZINE & CATALOGUE PRINTING.

ESTIMATES GIVEN PROMPTLY FOR THE FINEST WORK AT REASONABLE PRICES.

"NATURAL SCIENCE" is a Specimen of our Printing.
Also Printers of "ANNALS OF BRITISH GEOLOGY," by Professor BLAKE, M.A.
&c., &c.

OFFICE AND WORKS:

22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C.

PRINTED FOR THE PROPRIETORS BY RAIT, HENDERSON & CO., LIMITED,
22 ST. ANDREW STREET, LONDON, E.C.

ALL RIGHTS RESERVED.

Vol. V. No. 33

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

NOVEMBER, 1894.

CONTENTS.

		PAGE
	Notes and Comments — Change of Address — Marriage Customs of the Octopus — The Habits of a Crab — "The Toilers of the Sea" — In the China Sea — Echinoderms of the Macclesfield Bank — Fresh Forms of Foraminifera — The Life-History of Some Foraminifera — The Extermination of Big Game — Current African Exploration — Wasted Wealth in India — Fishing for Coal at Calais — "Mente et Malleo" — The Climbing Rabbit — The Gay Science of Newspaper Criticism.	321
I.	On Random Publishing and Rules of Priority. By Rev. T. R. R. Stebbing, M.A.	337
II.	Miocene Man in India. By Professor T. Rupert Jones, F.R.S. (Illustrated)	345
III.	The Wing of Archæopteryx. By W. P. Pycraft, M.B.O.U. (Illustrated)	350
IV.	Further Notes upon the Organs of Arachnids. By George H. Carpenter, B.Sc.	361
V.	Anlagen. By P. Chalmers Mitchell, M.A.	366
VI.	A Portable Zoological Station in Bohemia. (Illustrated)	372
	Some New Books — The Effect of External Influences on Development. By A. Weismann — From the Greeks to Darwin. By H. F. Osborn — The Great Ice Age. By J. Geikie — North American Zoology. By G. Ord — Deep-Sea Deposits. By J. Murray and A. F. Renard — The Fisheries of the Mediterranean. By P. Gourret — The Flora of Nebraska — The Geological Survey of the United Kingdom.	376
	Obituary — W. Topley — G. H. Cotteau — P. Albrecht — Robson Benson.	389
	News of Universities, Museums, and Societies	392
	Correspondence: — Frederic A. Lucas — P. Chalmers Mitchell — E. F. Linton — T. Johnson — J. R. Holt	395

LONDON AND NEW YORK: MACMILLAN & CO.

PRICE ONE SHILLING NETT.
In the United States, Thirty Cents.

LATEST PUBLICATIONS
OF THE
Zoological Society of London.

Transactions, Vol. XIII., Part 9, price 15s.; containing the following Paper:—"A Revision of the Genera of the *Alcyonaria stolonifera*, with a Description of some New Genus and several New Species." By Sydney J. Hickson, M.A., D.Sc., with Six Plates.

Proceedings of the Zoological Society of London, 1894, Part III., containing the Papers read at the Scientific Meetings held in May and June, 1894. With Fifteen Plates. Price 12s.

To be obtained at the Society's Office—

3 HANOVER SQUARE, W.,

OR THROUGH ANY BOOKSELLER.

WRIGHT'S COAL TAR SOAP

PROTECTS FROM FEVERS MEASLES SMALL POX &c.
A LUXURY FOR THE BATH
INVALUABLE FOR THE NURSERY
REFUSE ALL OTHER TAR SOAPS
PROMOTES THE HEALTHY ACTION OF THE SKIN
THE ONLY TRUE ANTISEPTIC SOAP—BRITISH MEDICAL JOURNAL
MOST EFFECTIVE IN SKIN DISEASES. LANCET
TABLETS 6d/-
SOLD EVERYWHERE.
RECOMMENDED BY THE MEDICAL FACULTY.

Watkins & Doncaster,
Naturalists,
36 STRAND, LONDON, W.C.
(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application

MUSEUM SPECIMENS

OF all classes of Marine Animals a speciality. *Sponges, Annelids, Molluscs* and *Tunicates* well displayed in finest glass museum jars in clear fluid. Price 2s. 6d. to 10s. each. Average 4s.

Collections of dried *Echinoderms* and *Crustaceans* in large and small series.

British Fishes by the famous Davidson process of Taxidermy. (Gold medal, Paris, 1889.)

SPECIAL.—Skeleton of *Scyllium* in museum jar, 18 in. high. Price 25s.

Disarticulated Lobster, a splendid preparation—all parts lettered, with text. 22s.

MICROSCOPICAL PREPARATIONS AND DISSECTING SPECIMENS.

Lists on Application.

SINEL & HORNELL, BIOLOGICAL STATION, JERSEY.

BREAKFAST—SUPPER.

EPPS'S
GRATEFUL-COMFORTING
COCOA
BOILING WATER OR MILK.

WANTED BY CAMBRIDGE GRADUATE.—Curatorship or Assistant-Curatorship in Public or Private Museum.—Apply M.A., 41 Grosvenor Road, Scarborough.

ALL APPLICATIONS FOR ADVERTISEMENT SPACE IN THIS JOURNAL SHOULD BE SENT TO

John Haddon & Co.,

BOUVERIE HOUSE,
SALISBURY SQUARE, LONDON, E.C

"NATURE,"
A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.		(To all places Abroad) £ s. d.
Yearly	1 8 0	**Yearly**	1 10 0
Half-Yearly	0 14 6	**Half-Yearly**	0 15 0
Quarterly	0 7 6	**Quarterly**	0 8 0

Money Orders to be made payable to MACMILLAN & CO. Office: 29 Bedford Street, Strand, London.

MESSRS. MACMILLAN & CO.'S

BOOKS FOR

Students of Physiography, Geology, and Mineralogy.

PHYSIOGRAPHY: an Introduction to the Study of Nature. With Illustrations and Coloured Plates. By T. H. HUXLEY, F.R.S. Crown 8vo. 6s.

OUTLINES OF PHYSIOGRAPHY—THE MOVEMENTS OF THE EARTH. By J. NORMAN LOCKYER, C.B., F.R.S. Crown 8vo. Sewed. 1s. 6d.

SOME BOOKS BY SIR ARCHIBALD GEIKIE, F.R.S.

ELEMENTARY LESSONS IN PHYSICAL GEOGRAPHY. Illustrated with Woodcuts and Ten Plates. Foolscap 8vo. 4s. 6d.

QUESTIONS ON GEIKIE'S ELEMENTARY PHYSICAL GEOGRAPHY. For the use of Schools. Foolscap 8vo. 1s. 6d.

PHYSICAL GEOGRAPHY. With Illustrations. Pott 8vo. 1s. [*Science Primers.*

TEXT-BOOK OF GEOLOGY. With Illustrations. Third Edition. Revised and Enlarged. Medium 8vo. 28s.

CLASS-BOOK OF GEOLOGY. Illustrated with Woodcuts. Second Edition. Crown 8vo. 4s. 6d.

GEOLOGY. With Illustrations. Pott 8vo. 1s. [*Science Primers.*

Box of Geological Specimens to illustrate Geikie's Primer of Geology. 10s. 6d.

TABLES FOR THE DETERMINATION OF THE ROCK-FORMING MINERALS. Compiled by F. LOEWINSON-LESSING, Professor of Geology at the University of Dorpat. Translated from the Russian by J. W. GREGORY, B.Sc., F.G.S., of the British Museum (Natural History), with a chapter on the Petrological Microscope by Professor G. A. J. COLE, M.R.I.A., F.G.S. Super Royal 8vo. 4s. 6d. net.

PHYSICS OF THE EARTH'S CRUST. By the Rev. OSMOND FISHER, M.A., F.G.S., Rector of Harlton, Hon. Fellow of King's College, London, and late Fellow and Tutor of Jesus College, Cambridge. Second Edition, altered and enlarged. 8vo. 12s.

ECONOMIC GEOLOGY OF THE UNITED STATES. With Briefer Mention of Foreign Mineral Products. By RALPH S. TARR, B.S., F.G.S.A., Assistant Professor of Geology at Cornell University. 8vo. 16s. net.

MICROSCOPICAL PHYSIOGRAPHY OF THE ROCK-MAKING MINERALS. An Aid to the Microscopical Study of Rocks. By H. ROSENBUSCH. Translated and abridged for use in Schools and Colleges by JOSEPH P. IDDINGS. Illustrated by 121 Woodcuts and 26 Plates of Photomicrographs. 8vo. 24s.

ELEMENTS OF CRYSTALLOGRAPHY FOR STUDENTS OF CHEMISTRY, PHYSICS, AND MINERALOGY. By GEO. HUNTINGDON WILLIAMS, Ph.D., Assistant Professor in the Johns Hopkins University. Crown 8vo. 6s.

MACMILLAN & CO., LONDON.

GEOLOGISTS' ASSOCIATION.

Meetings are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 King's Road, Chelsea.

The MAY No. *contains papers on*
GEOLOGY IN THE FIELD AND IN THE STUDY, by H. B. WOODWARD,
AND ON THE
GENESIS OF THE CHALK, by W. F. HUME.

The AUGUST No., Price 1s. 6d., *is now ready, containing papers on the*
GEOLOGY OF SOUTH SHROPSHIRE, by PROFESSOR LAPWORTH & W. W. WATTS;
(With two Plates and numerous Illustrations)
On CHALK IN HUNTINGDONSHIRE, by A. C. G. CAMERON;
AND ON
THE HYTHE BEDS OF THE LIPHOOK AND HINDHEAD DISTRICT, by B. FOWLER.

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY
WM. DENISON ROEBUCK, F.L.S.,
Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF
J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed
THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History
BOTANY. ZOOLOGY. GEOLOGY.
Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands.

Vol I. (1892), Price 3s. 6d. Vol. II. (1893), Price 5s. Vol. III. (1894) will be sent in monthly parts to any address for 5s.

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, A. G. More, Rev. W. F. Johnson, R. J. Ussher, R. Warren, Dr. V. Ball, Prof. W. J. Sollas, Prof A. C. Haddon, Rev. H. Friend, W. F. de V. Kane.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

TELEGRAPHIC ADDRESS:
"ADVERTENCE, LONDON."

TELEPHONE No. 2,895.

Rait, Henderson & Co.,

LIMITED.

Artistic Letterpress - -
- - and Lithographic

PRINTERS.

SPECIALISTS FOR

BOOK, MAGAZINE & CATALOGUE PRINTING.

ESTIMATES GIVEN PROMPTLY FOR THE FINEST WORK AT REASONABLE PRICES.

"NATURAL SCIENCE" is a Specimen of our Printing.
Also Printers of "ANNALS OF BRITISH GEOLOGY," by Professor BLAKE, M.A.
&c., &c.

OFFICE AND WORKS:

22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C.

PRINTED FOR THE PROPRIETORS BY RAIT, HENDERSON & CO., LIMITED,
22 ST. ANDREW STREET, LONDON, E.C.

ALL RIGHTS RESERVED.

Vol. V. No. 34

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

DECEMBER, 1894.

CONTENTS.

PAGE

Notes and Comments 401

The Scots Fishery Board—Science and the State—Geology in Queensland — The U.S. Geological Survey — A Geological Record — A Universal Zoological Record — The Linnean Society's Catalogue—Science and Medicine (Sir James Paget and Dr. Lauder Brunton)—Antitoxins—An Electrical Theory of Vision—Mind and Body—Realism in Art—Physiological Apparatus for Plants—The Discoverer of Dionæa—Change of Address.

I. The Homes and Migrations of the earliest known Forms of Animal Life, as indicated by Recent Researches. By Henry Hicks, M.D., F.R.S. 417

II. Cephalopod Beginnings. By F. A. Bather, M.A., F.G.S. (Illustrated) 422

III. The Wing of Archæopteryx. Part II. By W. P. Pycraft, M.B.O.U. (With Plate IV. and Text-Illustrations) 437

IV. Pseudo-Biology. By F. A. Bather 449

Some New Books 455

A Naturalist on the Prowl, or in the Jungle. By "Eha"—A Manual of the Geology of India. Second Edition. By R. D. Oldham—Amphioxus and the Ancestry of the Vertebrates. By A. Willey—Index Kewensis—The Orient Guide—Recent Journals and Pamphlets.

Obituary 464

N. Pringsheim—P. Duchartre—G. L. Figuier—L. Mauthner—Hugh Mitchell—O. Koechlin—B. N. Rake—H. Tate—Lent—Kretzschmar—G. L. E. Andreæ.

News of Universities, Museums, and Societies 467

Correspondence:—W. E. Hart—F. A. Bather—H. O. Forbes .. 471

LONDON AND NEW YORK: MACMILLAN & CO.

PRICE ONE SHILLING NETT.

In the United States, Thirty Cents.

LATEST PUBLICATIONS
OF THE
Zoological Society of London.

Transactions, Vol. XIII., Part 9, price 15s.; containing the following Paper:—"A Revision of the Genera of the *Alcyonaria stolonifera*, with a Description of some New Genus and several New Species." By Sydney J. Hickson, M.A., D.Sc., with Six Plates.

Proceedings of the Zoological Society of London, 1894, Part III., containing the Papers read at the Scientific Meetings held in May and June, 1894. With Fifteen Plates. Price 12s.

To be obtained at the Society's Office—

3 HANOVER SQUARE, W.,

OR THROUGH ANY BOOKSELLER.

WRIGHT'S COAL TAR SOAP

PROTECTS FROM FEVERS MEASLES SMALL POX &c.
A LUXURY FOR THE BATH. INVALUABLE FOR THE NURSERY
REFUSE ALL OTHER TAR SOAPS
PROMOTES THE HEALTHY ACTION OF THE SKIN
THE ONLY TRUE ANTISEPTIC SOAP BRITISH MEDICAL JOURNAL
MOST EFFECTIVE IN SKIN DISEASES. LANCET
TABLETS 6d/- SOLD EVERYWHERE.
RECOMMENDED BY THE MEDICAL FACULTY.

Watkins & Doncaster,
Naturalists,
36 STRAND, LONDON, W.C.
(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application

MUSEUM SPECIMENS

OF all classes of Marine Animals a speciality.

Sponges, Annelids, Molluscs and *Tunicates* well displayed in finest glass museum jars in clear fluid. Price 2s. 6d. to 10s. each. Average 4s.

Collections of dried *Echinoderms* and *Crustaceans* in large and small series.

British Fishes by the famous Davidson process of Taxidermy. (Gold medal, Paris, 1889.)

SPECIAL.—Skeleton of *Scyllium* in museum Jar, 18 in. high. Price 25s.

Disarticulated Lobster, a splendid preparation—all parts lettered, with text. 22s.

MICROSCOPICAL PREPARATIONS AND DISSECTING SPECIMENS.

Lists on Application.

SINEL & HORNELL, BIOLOGICAL STATION, JERSEY.

BREAKFAST—SUPPER.

EPPS'S
GRATEFUL-COMFORTING
COCOA
BOILING WATER OR MILK.

ALL APPLICATIONS FOR ADVERTISEMENT SPACE IN THIS JOURNAL SHOULD BE SENT TO

John Haddon & Co.,
BOUVERIE HOUSE,
SALISBURY SQUARE, LONDON, E.C.

"NATURE,"
A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.		(*To all places Abroad*) £ s. d.
Yearly	1 8 0	**Yearly**	1 10 6
Half-Yearly	0 14 6	**Half-Yearly**	0 15 6
Quarterly	0 7 6	**Quarterly**	0 8 0

Money Orders to be made payable to MACMILLAN & CO. Office: 29 Bedford Street, Strand, London.

MESSRS. MACMILLAN & CO.'S

BOOKS ON CHEMISTRY.

ESSAYS IN HISTORICAL CHEMISTRY. By T. E. THORPE, F.R.S., Professor of Chemistry in the Royal College of Science, South Kensington, London. Crown 8vo. 8s. 6d. net.

HISTORY OF CHEMISTRY from the Earliest Times to the Present Day. By ERNST VON MEYER, Ph.D. Translated by GEORGE MCGOWAN, Ph.D. 8vo. 14s. net.

EXPERIMENTAL PROOFS OF CHEMICAL THEORY FOR BEGINNERS. By WILLIAM RAMSAY, Ph.D., F.R.S., Professor of Chemistry in University College, London. Second Edition. Pot 8vo. 2s. 6d.

CHEMICAL THEORY FOR BEGINNERS. By LEONARD DOBBIN, Ph.D., and JAMES WALKER, Ph.D., D.Sc., Assistants in the Chemistry Department, University of Edinburgh. Pot 8vo. 2s. 6d.

OUTLINES OF GENERAL CHEMISTRY. By Prof. WILHELM OSTWALD. Translated by J. WALKER, D.Sc., Ph.D. 8vo. 10s. net.

THE RISE AND DEVELOPMENT OF ORGANIC CHEMISTRY. By CARL SCHORLEMMER, LL.D., F.R.S., late Professor of Organic Chemistry in the Owens College, Manchester, Victoria University. Revised Edition. Edited by ARTHUR SMITHELLS, B.Sc. Crown 8vo. 5s. net.

A TREATISE ON CHEMISTRY. By Sir H. E. ROSCOE, F.R.S., and the late C. SCHORLEMMER, F.R.S. Vol I. The Non-Metallic Elements. New Edition. Completely Revised by Sir H. E. ROSCOE, assisted by Drs. H. G. COLMAN and A. HARDEN. With 374 Illustrations and a Portrait of Dalton engraved by C. H. JEENS. 8vo. 21s.
Vol. II. Part I. Metals, 18s. Vol. II. Part II. Metals, 18s. Vol. III. Organic Chemistry. Parts I., II., IV., and VI., 21s. each. Parts III. and V., 18s. each.

INORGANIC CHEMISTRY FOR BEGINNERS. By Sir HENRY E. ROSCOE, F.R.S., assisted by JOSEPH LUNT, B.Sc. Globe 8vo. 2s. 6d.

LESSONS IN ELEMENTARY CHEMISTRY, INORGANIC AND ORGANIC. By Sir H. E. ROSCOE, F.R.S. Sixth Edition, thoroughly Revised. Fcap. 8vo. 4s. 6d.

A TEXT-BOOK OF INORGANIC CHEMISTRY. By Prof. IRA REMSEN. 8vo. 16s.

INORGANIC CHEMISTRY. By the same. Crown 8vo. 6s. 6d.

ORGANIC CHEMISTRY. By the same. Crown 8vo. 6s. 6d.

THE ELEMENTS OF CHEMISTRY. By the same. New Edition. Fcap. 8vo. 2s. 6d.

PRACTICAL INORGANIC CHEMISTRY. By FRANCIS JONES, F.R.S.E. Fcap. 8vo. 2s. 6d.

PRACTICAL ORGANIC CHEMISTRY. By J. B. COHEN, Ph.D. Fcap. 8vo. 2s. 6d.

LESSONS IN ORGANIC CHEMISTRY. Part I., Elementary. By G. S. TURPIN, M.A., D.Sc, Principal of the Technical School, Huddersfield. 2s. 6d.

A MANUAL OF MICROCHEMICAL ANALYSIS. By Prof. H. BEHRENS With an Introductory Chapter by Prof. J W. JUDD, F.R.S. 6s.

MACMILLAN & CO., LONDON.

GEOLOGISTS' ASSOCIATION.

Meetings are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 King's Road, Chelsea.

The **MAY No.** *contains papers on*
GEOLOGY IN THE FIELD AND IN THE STUDY, by H. B. WOODWARD,
AND ON THE
GENESIS OF THE CHALK, by W. F. HUME.

The **AUGUST No., Price 1s. 6d.,** *is now ready, containing papers on the*
GEOLOGY OF SOUTH SHROPSHIRE, by PROFESSOR LAPWORTH & W. W. WATTS;
(With two Plates and numerous Illustrations)
On CHALK IN HUNTINGDONSHIRE, by A. C. G. CAMERON;
AND ON
THE HYTHE BEDS OF THE LIPHOOK AND HINDHEAD DISTRICT, by B. FOWLER.

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed
THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands.

Vol I. (1892), Price 3s. 6d. Vol. II. (1893), Price 5s. Vol. III. (1894) will be sent in monthly parts to any address for 5s.

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, A. G. More, Rev. W. F. Johnson, R. J. Ussher, R. Warren, Dr. V. Ball, Prof. W. J. Sollas, Prof. A. C. Haddon, Rev. H. Friend, W. F. de V. Kane.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

TELEGRAPHIC ADDRESS:
"ADVERTENCE, LONDON."

TELEPHONE No. 2,895.

Rait, Henderson & Co.,

LIMITED.

Artistic Letterpress - - - - and Lithographic

PRINTERS.

SPECIALISTS FOR

BOOK, MAGAZINE & CATALOGUE PRINTING.

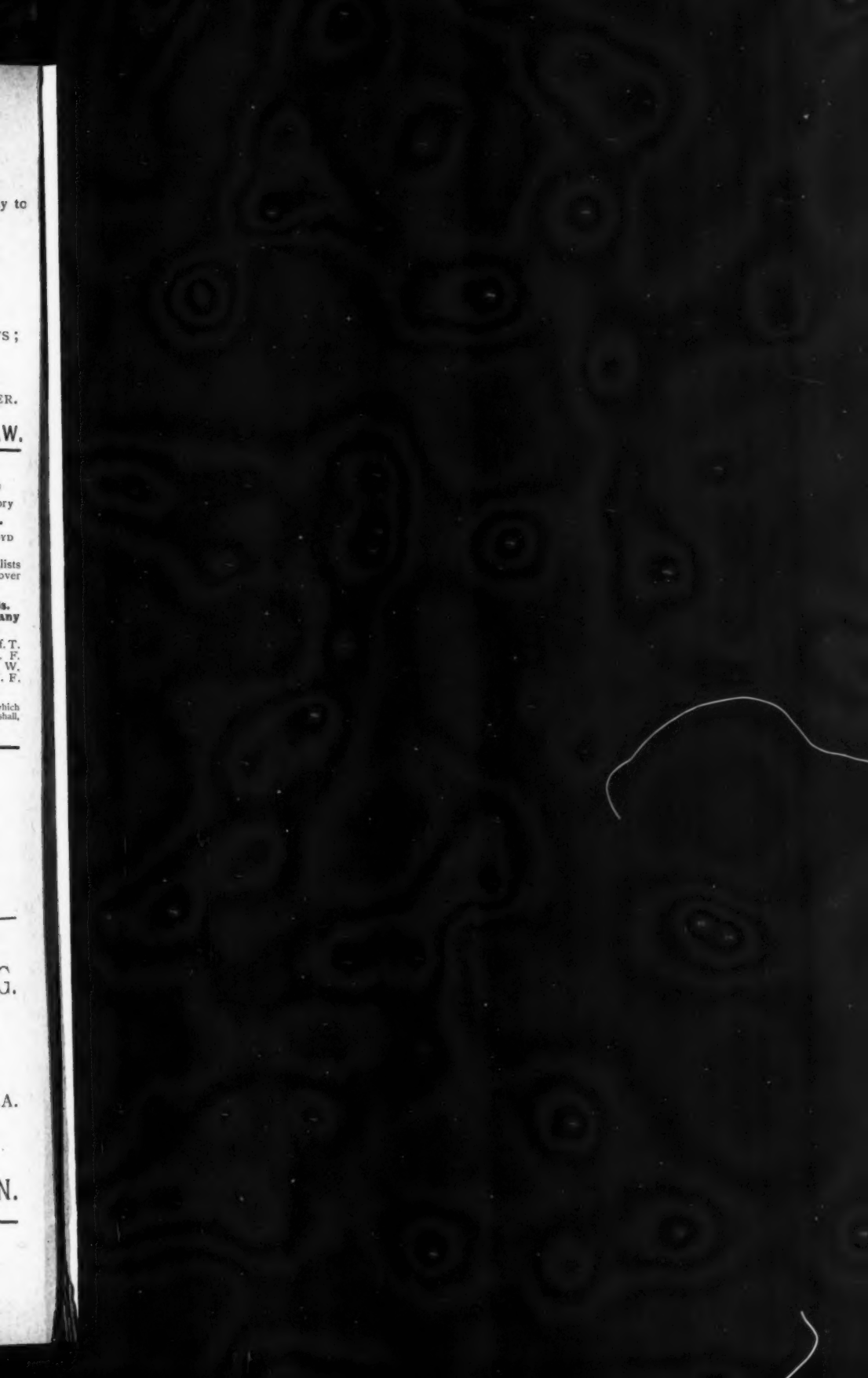
ESTIMATES GIVEN PROMPTLY FOR THE FINEST WORK AT REASONABLE PRICES.

"NATURAL SCIENCE" is a Specimen of our Printing.

Also Printers of "ANNALS OF BRITISH GEOLOGY," by Professor BLAKE, M.A.

&c., &c.

OFFICE AND WORKS:

22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON. E.C.

PRINTED FOR THE PROPRIETORS BY RAIT, HENDERSON & CO., LIMITED, 22 ST. ANDREW STREET, LONDON, E.C.